Engineering News

Vol. 67. 505 Pearl Street, New York No. 6

The St. Louis Municipal Bridge

By S. W. Bowen*

The St. Louis Municipal Bridge, now being built across the Mississippi River, connects the cities of St. Louis, Mo., and East St. Louis, Ill., and is being constructed by the city of St. Louis as a combined railway and highway structure.

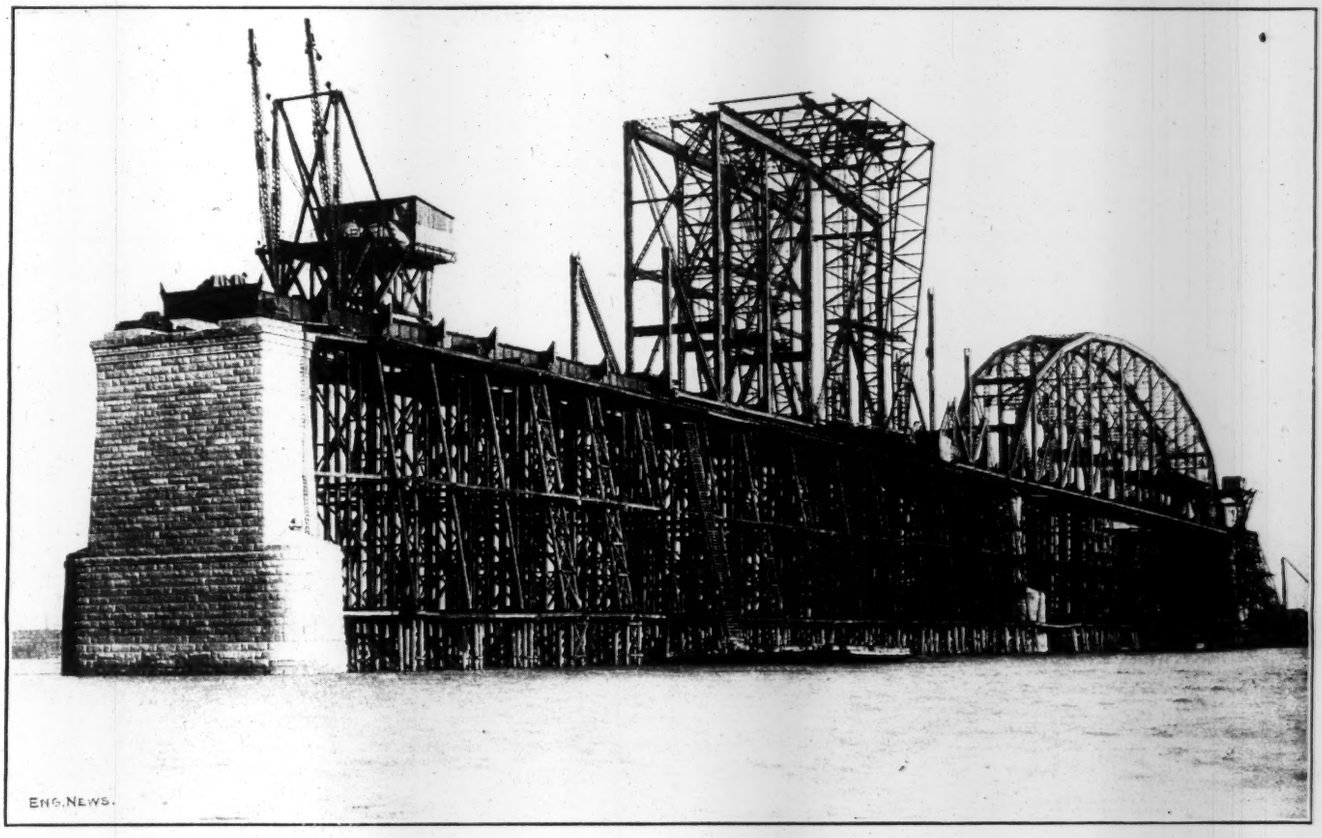


Fig. 1. Erection of the Municipal Bridge Over the Mississippi River at St. Louis, Mo.

(From a photograph taken in November. The east span was then completed, except a part of the upper deck, and the falsework was being removed. The middle or second span had the floor system in place and the main traveler was erecting the trusses. The smaller traveler at the left was used for erecting the falsework and the floor system.)

The superstructure of the river crossing consists of three simple truss spans of the Petit type, each having a length of 668 ft. c. to c. of end pins. The substructure has been described in a previous article (Engineering News, Mar. 16, 1911).

The position of the shore piers, the minimum span length and the clearance above high water were all made to conform to the requirements of the Secretary of War.

The original plans submitted to the War Department called for three spans each of about 500 ft. clear between piers at low-water line. The vertical clearances were 50 ft. at the shore piers, and 53.4 ft. at the center of the middle span, above the high-water line of 1844. These spans are about the same as for the Merchants and McKinley bridges, the two structures spanning the Mississippi at St. Louis, just above the Eads Bridge. The vertical clearances are somewhat greater than for the above-named bridges. On these plans the shore piers were placed just inside of the outer harbor lines, or at the foot of the levee slope on the Missouri side, and opposite the end of the Pittsburg dike on the Illinois side.

The War Department, however, ruled that the Eads Bridge was the dividing line between the upper and lower river, and that therefore, the spans and clearances of the Municipal Bridge must conform, in general, to those of the first existing crossing south of the Eads Bridge, which is at Thebes, Ill., about 200 miles below St. Louis. In addition to this, the shore piers were required to be placed inside of the inner harbor lines. The central span of the Thebes Bridge is 650 ft. in the clear, with a vertical clearance of 65 ft. above the high-water line of 1844.

New plans showing three approximately equal spans of about 650 ft. in the clear, with a clear height of 65 ft. above the high-water line of 1903, were then submitted, and finally approved by the Secretary of War. These changes increased the length of the river crossing 500 ft. and the elevation of the clearance line some 12 ft., thus increasing very materially the cost of the river spans

*Engineer in charge for Brenneke & Fay, St. Louis, Mo.

and approaches. The spans and clearances, as well as the general dimensions of the structure, are shown on the profile elevation.†

Fig. 1 shows the completed east span on the falsework, and erection commenced on the second or middle span.

Design of Superstructure

The structure has two decks; the lower of these carries two steam-railway tracks, while the upper supports two tracks for an electric interurban railway on a 30-ft. paved roadway. Two 6-ft. sidewalks at the level of the upper deck are carried on cantilever brackets outside of the trusses. The roadway is paved with creosoted wood blocks on a reinforced-concrete slab supported on the stringers; the sidewalk slabs are also of reinforced concrete. The cross-section of the span, Fig. 2, shows the arrangement of tracks, etc., as well as the construction.

On the stress sheet, Fig. 3, shown herewith, are given the loading and the stresses used in the design of the steelwork, and the makeup of the various members. All main truss members, both tension and compression, are of nickel steel. Carbon steel is used for the secondary truss members, railway and highway-floor systems, and for all bracing. Such details as batten plates and lacing are also of carbon steel.

[The live loads for the floor systems and the secondary truss members are shown in Fig. 4. For the trusses they are as follows: (1) On each railway track, 5000 lb. per lin.ft., with two concentrations of 130,000 lb. each, placed one panel apart; (2) on each trolley track, 1400 lb. per lin.ft.; (3) on the roadway, 75 lb. per sq.ft., 10 ft. wide, 750 lb. per lin.ft.; (4) on the sidewalks, 60 lb. per sq.ft., 12 ft. wide (two walks, 6 ft. wide), 720 lb. per lin.ft. Wind loads: Upper laterals, 300 lb. per lin.ft.; lower laterals, 300 lb. per lin.ft. moving and 300 lb. fixed, 600 lb. per lin. ft. The unit stresses are given in Table I.—Editor.]

A novel feature of the design is the construction of the top chords and end posts. In all of these members, three webs are used, composed of plates and angles. These webs are connected together along the neutral axis by means of continuous longitudinal diaphragms of plates and angles. The flanges of the webs are stayed by lacing composed of 5-in. 11.5-lb. channels. At intervals of about 10 ft. transverse diaphragms are introduced to prevent the member from becoming distorted while being handled. This type of cross-section is well adapted to withstand high unit-stresses, as the longitudinal diaphragms support the webs at the middle of their depth and tend to prevent them from distorting laterally, while the lacing systems prevent the distortion of the flanges and edges of the webs. As the longitudinal diaphragms are counted in as stress-carrying material and act also as lacing, the member is lighter than would be the case if only lacing were used to stay the webs and flanges. At the ends of the members where the longitudinal diaphragms stop, the necessary cross-sectional area is supplied by means of pin plates.

Fig. 5 shows the size and makeup of one of the end posts. This member (a view of which is shown in Fig. 6) is about 85 ft. long c. to c. of pins and weighs about 70 tons. The heaviest member in the structure is the middle section of the top chord, which is 96 ft. long c. to c. of pins and weighs about 83 tons. The cross-sectional area of this chord is 441.11 sq.in. The ends of the top-chord members are faced to bear on each other, the pins and pin plates merely transferring the components parallel to the chords of the stress in the diagonal members. The one exception to this rule is the joint at U2, which has a full pin bearing. No hinge plates are used on any top chords or end posts, and only on the diagonal web members where they are required for structural reasons, or to provide for reversal of stress. This arrangement greatly facilitated the erection, as the members could be placed much more easily than would have been possible had all members been built with full holes. The last pin could also be driven without the members being in exact position relative to each other and to the pin.

The contractor was given the option of splicing the top chords and end posts at the subpanel points, or of making them in full panel lengths, and he chose the latter method.

Riveted members capable of taking either compression or tension, are used when reversal of stress occurs, except in the case of members M5-L6. Here the ruling stress is tension and is very much in excess of the compression. This member is therefore made to take care of the stresses independently, the compression being taken by a latticed built member of plates and angles, and the tension by four eyebars, two placed outside and two inside of the compression member.

The pins range in size from 10 to 15 in. diameter and are all bored with 2-in. axial holes, through which 1⅞-in. rods pass to secure the cast-steel caps in place. The main shoes are of cast steel and rest on granite bridge seats. These seats were bush-hammered to a water level, and the shoes set on a thin bed of cement grout. The shoes are secured to the bridge seats by means of anchor bolts grouted into holes drilled into the granite after the shoes are placed. Segmental expansion rollers, 15x8 in., are used on the shoes at the east end of each span.

The contract for furnishing and erecting the steelwork was awarded to the American Bridge Co. Bids were taken on the "nickel-steel" design shown on the stress sheet, as well as on an alternative design in which all members except

†Engineering News, March 16, 1911.

TABLE I. UNIT-STRESSES FOR THE RIVER SPANS OF THE MUNICIPAL BRIDGE AT ST. LOUIS, MO.

		Live	Dead
(A) Carbon steel:			
Flanges of railway stringers and floorbeams		10,000	10,000
Flanges of highway stringers and floorbeams		12,500	12,500
(B) Nickel steel:			
Bottom chord and main diagonals	(eyebars)	16,000	32,000
Main diagonals	(riveted)	13,000	26,000
Long verticals		12,000	24,000
Outside fibers of pins		36,000	36,000
Power-driven rivets and pins	(shearing)	14,000	14,000
Hand-driven rivets	(shearing)	11,200	11,200
Power-driven rivets	(bearing)	22,000	22,000
Hand-driven rivets	(bearing)	17,600	17,600
Pins	(bearing)	24,000	24,000
Compression members having $l \div r$ less than 40		15,000	30,000
For lengths over $40 \times r$		$17{,}000 - 55\frac{l}{r}$	$34{,}000 - 110\frac{l}{r}$
Inclined posts		$14{,}000 - 45\frac{l}{r}$	$28{,}000 - 90\frac{l}{r}$
(C) Carbon steel:			
Wind bracing	(compression)	$15{,}750 - 60\frac{l}{r}$	$15{,}750 - 60\frac{l}{r}$
Wind bracing	(tension)	13,500	13,500
Power-driven rivets	(shearing)	10,000	10,000
Hand-driven rivets	(shearing)	8,000	8,000
Power-driven rivets	(bearing)	16,000	16,000
Hand-driven rivets	(bearing)	12,800	12,800
Rivets for bracing	(shearing)	15,000	15,000
Rivets for bracing	(bearing)	24,000	24,000
Vertical sub-posts			$24{,}000 - 80\frac{l}{r}$

TABLE II. WEIGHT OF MATERIAL IN THE RIVER SPANS OF THE MUNICIPAL BRIDGE AT ST. LOUIS

	Cast Steel, Pounds	Carbon Steel, Pounds	Nickel Steel, Pounds	Total	Per Cent.
Pedestals and shoes	510,000	.....	.....	510,000	1.85
Pins and nuts	.....	19,000	458,000	477,000	1.73
Rollers	.....	126,000	.....	126,000	0.46
Railway floor	.....	3,791,000	.....	3,791,000	13.70
Highway floor	.....	4,107,000	.....	4,107,000	14.90
Laterals and trans. br.	.....	1,067,000	.....	1,067,000	3.86
Trusses; bars	.....	.....	6,753,000	6,753,000	24.50
Trusses; b'lt. mems	.....	1,810,000	8,959,000	10,769,000	39.00
Totals	510,000	10,920,000	16,170,000	27,600,000	100.00

eye-bars and pins were to be of carbon steel, the bars and pins to be of nickel steel. The low bid on each of these designs was $1,393,931, or 4.28c. per lb., for the "carbon-steel" design, and 5.05c. per lb. for the "nickel-steel" design. A pound price for extras was also specified; this was 5.6c. for nickel steel and 3.95c. for carbon steel. As the general preference was for nickel steel, this design was adopted. The material was fabricated at the Ambridge plant.

In addition to the regular shop inspection, all work was inspected by Robert W. Hunt & Co., who were employed by the consulting engineers to do this work.

Aside from the usual diffifficulties in manipulating nickel steel, the shop had no great trouble with the fabrication of the work, although some of the members were of unusual size.

The shop work was remarkably good and the number of shop errors found and corrected in the field was very small.

The total shipping weight of the three spans is about 13,935 tons, while the weight as estimated by the engineers from their plans was about 13,800 tons. This weight was divided as shown by Table II. The weight of the steelwork used in computing the final dead-load stresses exceeds the actual shipping weight by less than 2%. These loads are distributed to the various panel points according to the estimated weights of the various members. There are approximately 109,000 field rivets required for the three spans, of which about 8% are of nickel steel, the remainder being of carbon steel. The number of rivets per ton of material is about eight.

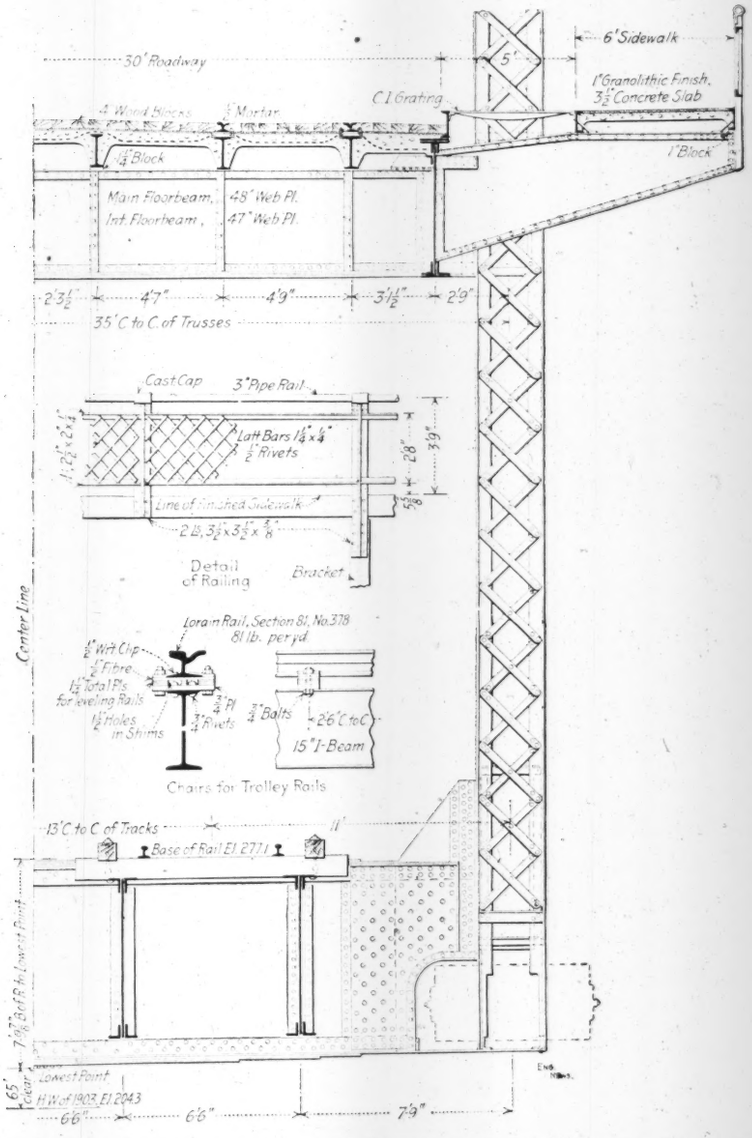


FIG. 2. HALF CROSS-SECTION OF THE MUNICIPAL BRIDGE AT ST. LOUIS, MO.

ERECTION PLANT AND METHODS

The storage yard was located on the east side of the river for two reasons: (1) Lack of sufficiently large unoccupied space on the St. Louis side, near the bridge site, and (2) the avoidance of the transfer of material across the river, the material being shipped in from the east.

The ground in the immediate vicinity of the east end of the bridge being too low to serve as a site for the storage yard, it was found necessary to go about ¼ mile south, where a tract of land was found of sufficient size and above the average high-water stage. Tracks were laid out on this property, and the steel stored as it arrived, in accordance with a prearranged plan. Each class of members was assigned to a certain place, as shown on a plan of the yard, so that any member could be readily located. A woodworking mill was built for framing the falsework and traveler timbers, and a bunk house and commissary building was put up to provide for the men employed in the yard.

The program of erection provided for erecting the three spans in order, beginning at the east end of the structure. Permission was obtained from the War Department to close two spans with falsework at the same time, provided that the third span be kept perfectly clear. The scheme of erection is, in general, as follows: The framed falsework bents are erected in place on the pile foundation bents, by means of a double-boom steam viaduct traveler, running on the railway floor. This is shown at the left in Fig. 1. This traveler, after placing the bents, places the camber blocking and the stringers, floor beams and bracing of the railway floor system. The main trusses and truss bracing are erected by the gantry or main traveler, which is equipped with electric power. The high-way-floor system is placed by a small, single-boom steam traveler, running on the stringers of the upper deck.

The viaduct traveler or "mule" is built of timber, with the exception of the two masts and booms at the front end. The booms are operated by two steam hoisting engines, which are located on a raised deck. The traveler is so constructed that there is sufficient clearance between the bridge floor and the engine deck to allow cars of material to pass through, so as to be picked up by the booms. The entire machine is mounted on wheels and travels on two lines of single rails, one over each outside railway stringer. The small traveler used for placing the high-way-floor system is also constructed of timber, with the exception of the boom, and is operated by a single steam hoisting engine. This traveler is mounted on wheels, and travels on two lines of rails, supported on the I-beam stringers.

The main traveler (Fig. 7) consists of three gantry bents, supported on sills, which are mounted on wheels and run on standard-gage tracks, one on each side of the falsework. The bents are braced together with timber struts and steel

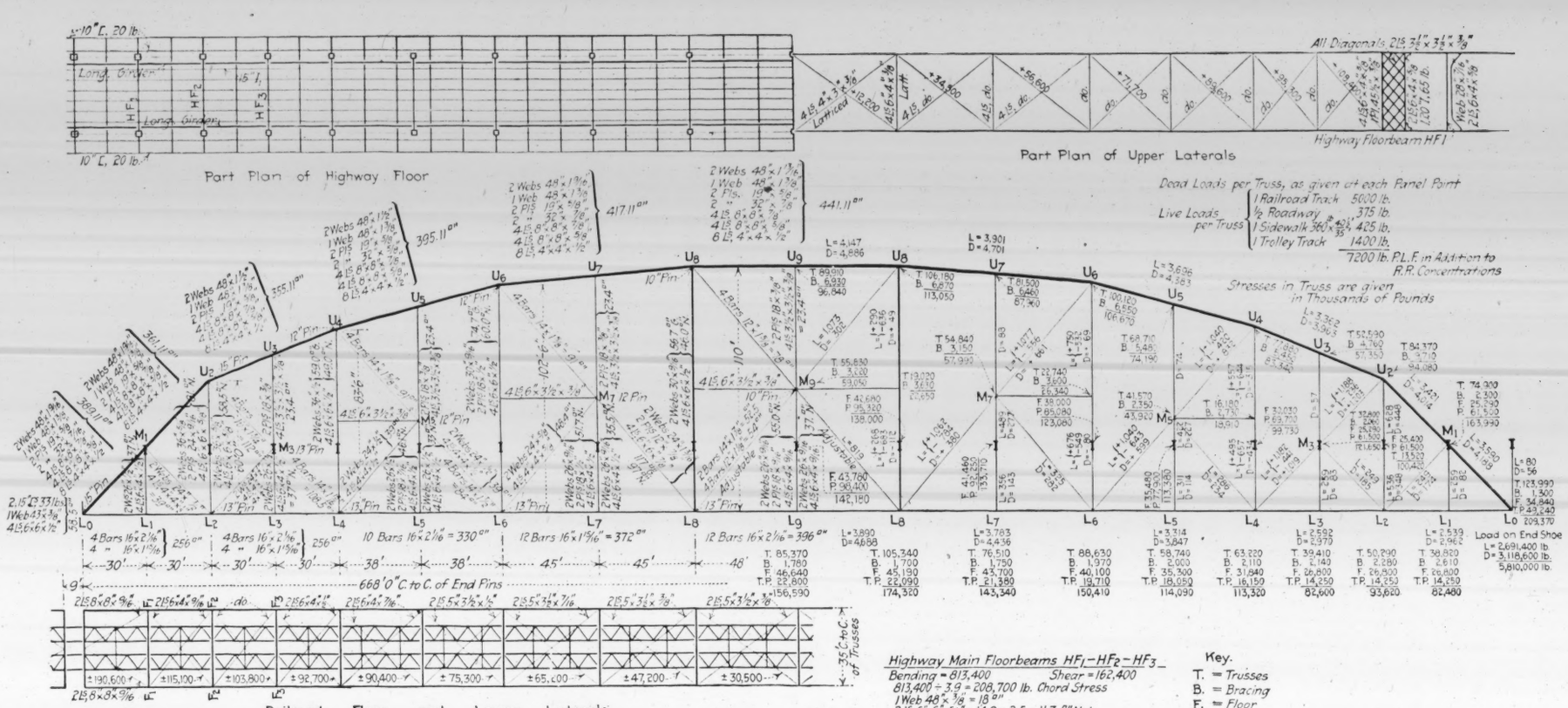

Part Plan of Highway Floor
Part Plan of Upper Laterals
Dead Loads per Truss, as given at each Panel Point
Live Loads per Truss
Stresses in Truss are given in Thousands of Pounds
Railroad Floor and Lower Laterals
668'0" C. to C. of End Pins
Highway Main Floorbeams HF1-HF2-HF3
Highway 38 Ft. Longitudinal Girder
Floorbeams F1-F2-F3
38 Ft. Railroad Stringers
Key.
T. = Trusses
B. = Bracing
F. = Floor
P. = Paving
T.P. = Track & Pipes

FIG. 3. STRESS SHEET OF THE MUNICIPAL BRIDGE, AT ST. LOUIS, MO.

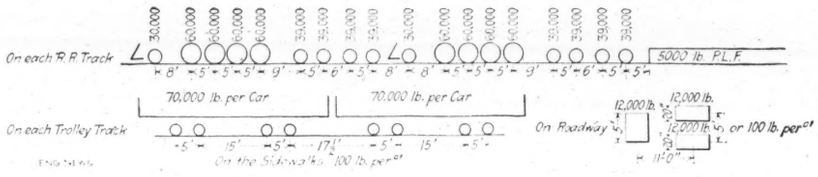


FIG. 4. LIVE LOADS FOR FLOOR SYSTEMS AND SECONDARY TRUSS MEMBERS

diagonal rods. The legs of the bents and the chords of the trusses are of 12x12-in. timbers, the sills 8x16 in., and the bracing 4x8 in. All connections are bolted. The splices of the legs are of four angles inclosing the sticks, and heavy steel gusset plates are used at all principal points. The loading beams are steel I-beams. The traveler is equipped with eight sets of falls, four on each side, composed of six-sheave steel blocks reeved with wire rope. In addition to this, there are 16 single manila lines or runners, eight on each side, for handling the lighter pieces and holding them in position while connections are being made. The working platforms are raised and lowered by means of tackle, so that the pins at the various points can be readily driven. Power for operating the traveler

is furnished by two 100-hp. direct-current electric hoists, each having 4 drums and 8 spools. These hoists are mounted on trucks and run on the traveler tracks, one being attached to each sill of the traveler like a trailer.

In order to get material from the surface track on which it is received from the storage yard, to the track on the level of the bridge floor, a double hoisting trestle was constructed just east of Pier IV, as shown in Fig. 8. The low-level track runs between these two trestles, while the high-level track is supported on the upstream trestle. Spanning these two tracks and supported on the two trestles are two 83 hp. alternating-current electric gantry cranes, one of which is stationary, and the other travels on tracks laid on the trestles. The members are loaded on cars at the yard, by locomotive cranes or stationary derricks, depending on the weight of the member; hauled to the bridge site, raised by the gantry hoists, and deposited on cars on the high-level track. These cars are then pushed out to the traveler by means of a small locomotive. In the case of short members carried on single cars, car and contents are hoisted together, thus avoiding several lifts and the transfer of members from car to car. These gantries are shown in Fig. 8.

The electric current for operating the two material hoists and the main traveler is obtained from East St. Louis, and is reduced in voltage in the power house at the bridge site. The power house also contains two boilers, which supply steam to the two air compressors. The compressors furnish air for the wood-boring machines and riveters, as well as for an engine on the diver's barge, which handles bracing and staging for the divers. A 4-in. pipe leads from the compressors out along the falsework, with valves and connections at convenient intervals, and another pipe of the same size leads to the lower deck of the bridge and out along the bridge floor. With the exceptions noted above, steam power is used for all derricks and cranes.

Work was started on the hoisting trestles on May 1, 1911. Piles were driven by means of a pair of leads suspended from the 60-ft. boom of a locomotive crane. This rig proved to be very efficient, and piles could be driven at any desired batter. On top of these hoisting trestles a temporary floor was laid, supported on I-beams. On this floor the "mule" was erected. While this work was going on, the falsework piles were being driven, capped and braced.

The falsework (Figs. 9 and 10) consists of pile bents surmounted by two-story framed-timber bents. The piles supporting the framed falsework bents are of yellow pine and range in length from 60 to 100 ft. Each bent consists of a double row of piles; the total number per bent varying from 28 to 40, depending on the load to be supported. The total number of piles per span is 608. Piles were arranged to take a maximum load of about 20 tons, and were driven by means of a No. 1 Vulcan steam hammer, until at least 20 blows were required to drive 1 ft. The piles of each bent were braced together in both directions above the water line, and where the depth of the water exceeded about 20 ft. below zero of the gage, submarine bracing was put on by divers. The piles were capped at about a 25-ft. stage of water, which is the average high-water line. Two floating drivers were used the greater part of the time, although the work was started with one driver.

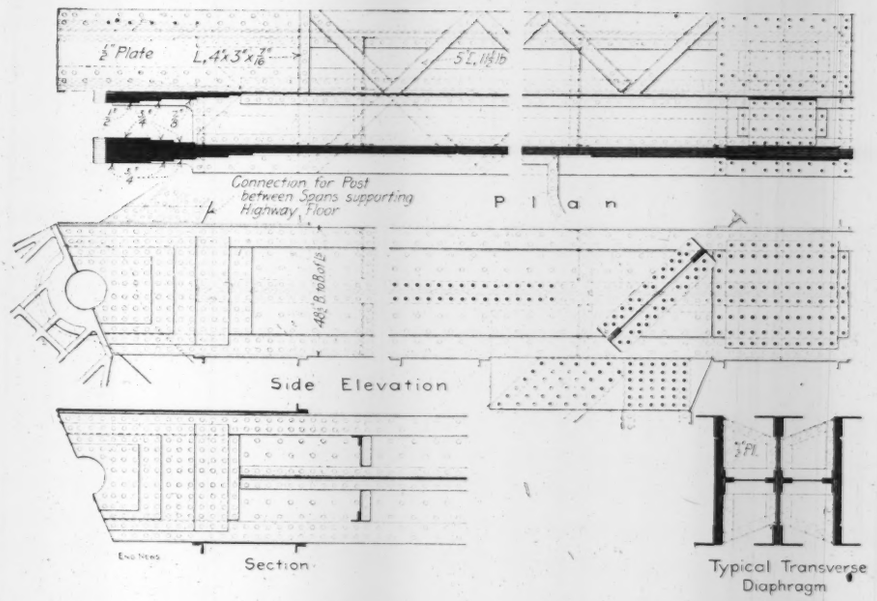


FIG. 5. DETAILS OF END POST

The framed-timber bents, surmounting the pile foundations, are constructed with 12x12-in. posts, caps and sills. Longitudinal struts are 8x12 in.; transverse bracing, 4x8 in., and the sway bracing between bents is of 1¼-in. round rods. All timber is yellow pine. No drifts are used as in permanent timber structures, but the posts are connected to the caps and sills, and to each other by means of flat steel scabs. Some of these scabs also serve to connect the sway rods to the bents. As all connections are bolted, the bents can be readily dismantled.

The timbers were framed in the material yard; one bent being first framed and assembled complete, to guard against mistakes. All sticks were framed from templates. The traveler tracks and camber blocking are supported on lines of steel I-beams. There are four lines of 20-in. 65-lb. I-beams under each traveler track, and four lines of 15-in. 42-lb. I-beams under each truss, to support the camber blocking. These beams lap 11 ft. at each panel point. All these beams are perfectly plain, and can be put back in stock when the job is finished.

FIG. 6. TRANSPORTATION OF 70-FT. SECTION OF END POST FOR THE MUNICIPAL BRIDGE, ST. LOUIS, MO.

The timbers for each bent of falsework were loaded on cars as needed and hauled to the bridge site, where they were run out on a trestle at the downstream side of the falsework. They were then assembled on barges by means of a stationary derrick, and bolted together to

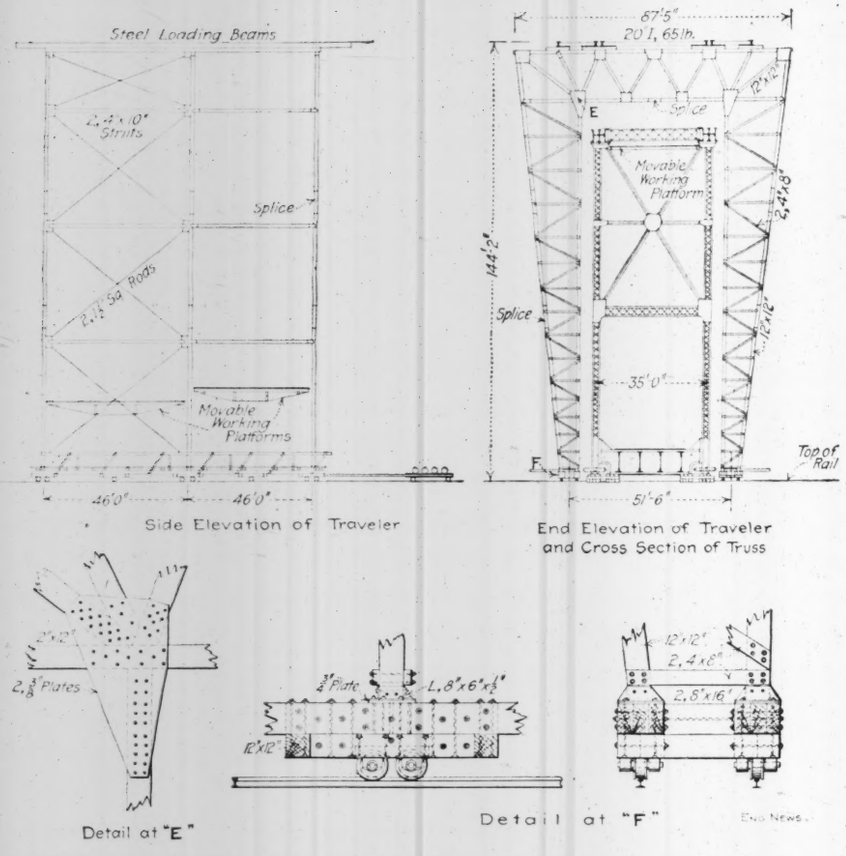


FIG. 7. MAIN TRAVELER FOR ERECTING THE TRUSSES OF THE MUNICIPAL BRIDGE

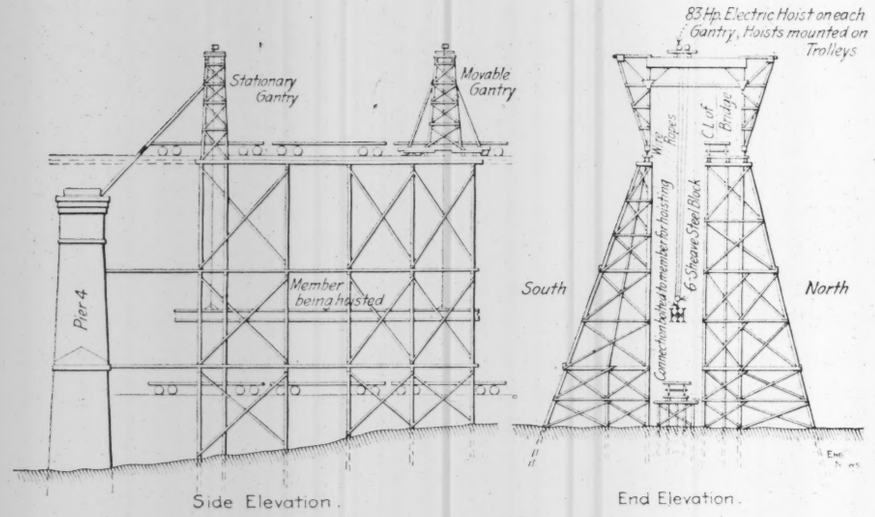


FIG. 8. GANTRY CRANES FOR HOISTING STEELWORK FROM SUPPLY TRACK TO THE FALSEWORK

form each story of the bent. The two stories forming a complete bent were assembled on top of each other on one barge. These barges were then towed alongside the falsework and the bents were picked up by the "mule" and placed in position. Each one was handled in four sections.

By the time the "mule" was ready for use, the first timber-falsework bents had been assembled. They were then picked up and placed in position by the "mule," together with the I-beam stringers and camber blocking. The main shoes and the first panel of floor system was then set, a temporary track laid on the stringers, and the "mule" advanced one panel length and placed the next bent of falsework. This process was repeated until the center of the east span was reached, when the material for the gantry traveler was brought to the bridge site and hoisted to the top of the falsework, where it was assembled by the "mule," in position to raise.

The gantry traveler had been framed and assembled in the material yard and was knocked down for shipment to the bridge site. Each of the bents of the traveler was knocked down in eight pieces; the sills were handled in one piece. The bents were bolted together on blocking, the lower ends resting on the sills, which had been placed in position on the traveler tracks, the bents overlapping each other. In raising them, a tipper bent was attached to the lower end of the first one, the blocks and lines being arranged as shown in Fig. 11. The bent was then tipped up into position, the power being furnished by two electric hoisting engines belonging to the traveler. One engine was located on each side of the falsework on the traveler tracks. The other two bents were raised in the same manner. As soon as the three traveler bents were raised and braced, the "mule" moved forward, through the gantry traveler, and after clearing up the blocking on which the bents had rested, resumed the work of building falsework. Meanwhile the gantry was being rigged and preparation made to begin the erection of the trusses.

The erection of the main trusses of the east span was started on Sept. 11. The posts were first placed and bolted to the floor beams and bottom laterals, then the bottom-chord bars, diagonals, etc., were placed in position and the bottom-chord pins driven as each joint was packed. When the middle of the span was reached, the middle panel (8-8) was erected complete and all bracing bolted up. The traveler then completed the next panel toward the west, in order to distribute the load onto the bents to the west, as the center bent had been somewhat weakened by the scouring of the river bed at the center of the span.

After this, the traveler moved back toward the east and completed each panel as it went, until the east end of the span was finished. Later the west end of the span was erected and the traveler then moved on and began the erection of the middle span. All lifts, wherever possible, were made simultaneously on both sides. The top-chord sections were handled by means of heavy bent plates bolted to the flange angles of the middle web. These plates were in pairs and were connected to the falls by means of pins passing through them.

The spans are cambered for dead load only. The camber at the center of the span, for the unstrained position of the truss, amounts to about 7 in. In order to provide for compression in the various joints of the falsework, and a possible settlement of the piles, under the weight of the steelwork and traveler, an arbitrary camber of about 6 in. was added. This proved to be sufficient to keep the

points above the line of no stress until the blocking was lowered and the span swung.

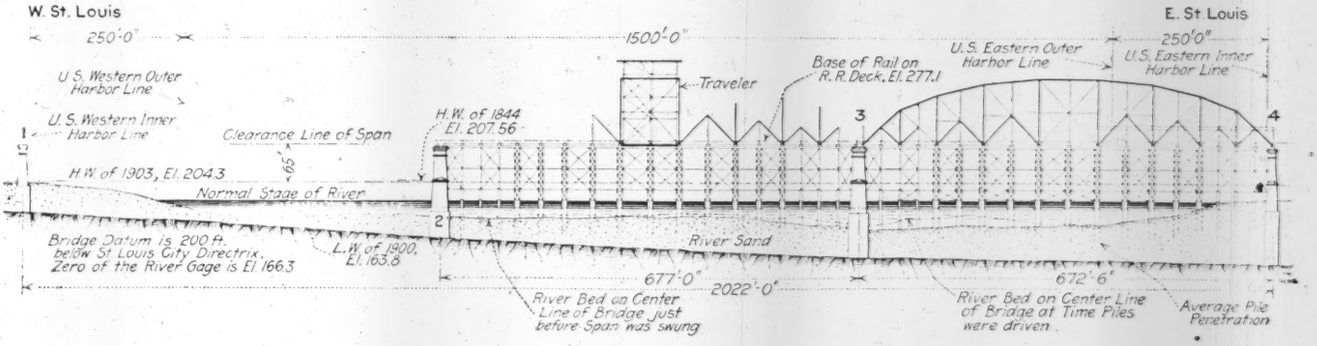
No riveting was done until the span was free of the blocking. Work was then started on the railway-floor system and bottom laterals. All rivets were driven with pneumatic hammers and pneumatic dollies were used wherever possible.

Although no unusual difficulties were encountered in getting good carbon-steel field rivets, the nickel-steel rivets were exceedingly hard to drive. A great many had to be cut out and re-driven, and this frequently loosened the adjoining rivets, which were apparently tight originally. Wherever the clearances permitted, these rivets were driven with two pneumatic hammers, one on each head. This gave much better work than when only one hammer was used, but was not always entirely satisfactory. These rivets cool very fast, and it is difficult to start them hot enough, without burning. This accounts, to some extent, for the difficulty of getting them tight, although the high elastic limit and consequent stiffness of the sheets has something to do with it.

Before any of the steel work was placed is position, the distances c. to c. of piers were measured with a long tape furnished by the American Bridge Co. The pier centers, which had previously been established by triangulation, consisted of brass tacks set in the concrete.

A base line was first laid out, 672 ft. 6 in. long, which is the plan distance c. to c. of piers, of the side spans. The length of this line was established by repeated measurements with a 100-ft. base-line tape. After all corrections had been made and the position of the end tacks established beyond question, the long tape was stretched out and supported at the two ends of the base line. Each end of the tape was supported on a pair of light timber shears, guyed back to a stake; the tape had metal tags at each 100-ft. point, and was provided with clamps, turnbuckles, plumb-bobs and a heavy spring balance. This latter was not graduated in pounds, but had divisions corresponding to the unsupported length of the tape. The zero end of the tape was first adjusted approximately over one end of the base line, a plumb-bob being hung from the marker on the tape.

Tension was then applied by taking in the slack on the guy lines, until the tape hung clear, and the spring balance at the head end read approximately 700 ft. The turnbuckles were then brought into play and the zero point carefully adjusted over the end base-line tack, while the spring balance was brought to the 700-ft. mark.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1500'0"
250'0"
U.S. Western Outer Harbor Line
U.S. Western Inner Harbor Line
Clearance Line of Span
65'
H.W. of 1903, El. 204.3
Normal Stage of River
Bridge Datum is 200 ft. below St Louis City Directrix. Zero of the River Gage is El 166.3
L.W. of 1900, El. 163.8
Traveler
Base of Rail on R.R. Deck, El. 277.1
H.W. of 1844 El. 207.56
U.S. Eastern Outer Harbor Line
U.S. Eastern Inner Harbor Line
River Sand
677'0"
2022'0"
672'6"
River Bed on Center Line of Bridge just before Span was swung
River Bed on Center Line of Bridge at Time Piles were driven
Average Pile Penetration

FIG. 9. FALSEWORK FOR THE RIVER SPANS OF THE MUNICIPAL BRIDGE, ST. LOUIS, MO.

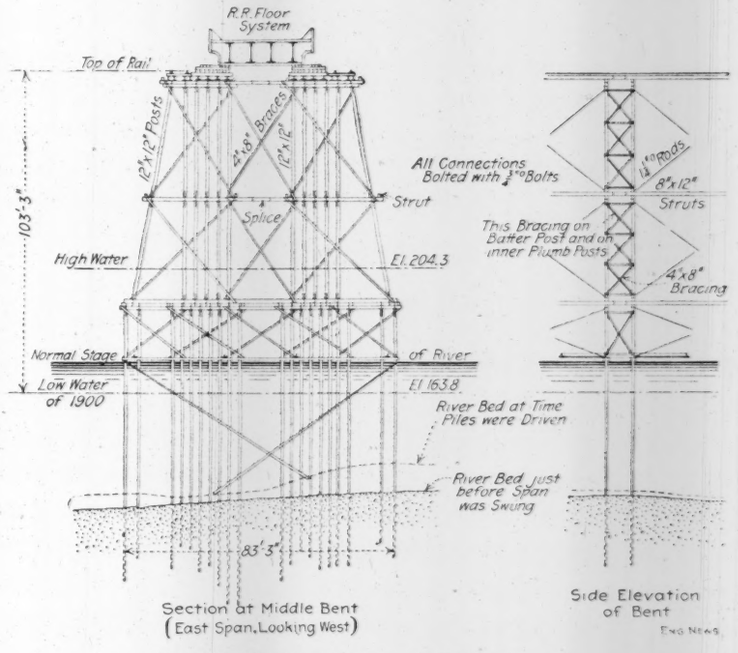


FIG. 10. CROSS-SECTION OF FALSEWORK

A small marking clamp was then slid along the tape until a plumb-bob suspended from it, hung directly over the tack at the head end of the base line. The position of the marking clamp was then marked on the tape and the temperature noted. As a check on the accuracy of the work, the tension was relaxed and then applied again, correction being made for the change of temperature that had occurred. It was found that the marker could be reset within $\frac{1}{16}$ in. of the original position. After this preliminary work was finished, the tape was taken down, stretched from pier to pier and supported on the piers under exactly the same tension as before. By making the proper temperature correction, the distance c. to c. of piers was determined.

As the effect of the wind on the long tape produced some horizontal deflection, a second measurement was made, as soon as the falsework was completed. The tape in this case was supported on the caps of the falsework bents. In order to calibrate the tape for this second measurement, it was stretched out on the base line, and supported on stakes driven into the ground at intervals, corresponding to the spacing of the falsework bents, the tops of the stakes being level. Owing to the accidental breaking of the long tape, a piano wire was used in making the second measurement. A pull of 50 lb. was used on the wire when supported on the stakes, as described above. The results of the measurements made to date are given in Table III.

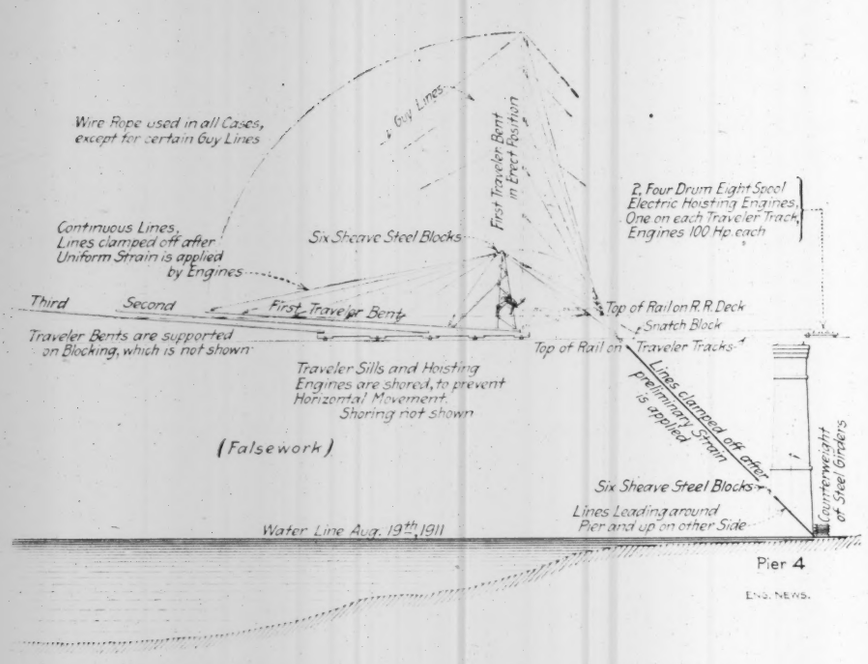

Wire Rope used in all Cases, except for certain Guy Lines
Guy Lines
First Traveler Bent in Erect Position
2, Four Drum Eight Spool Electric Hoisting Engines, One on each Traveler Track, Engines 100 Hp each
Continuous Lines, Lines clamped off after Uniform Strain is applied by Engines
Six Sheave Steel Blocks
Third
Second
First Traveler Bent
Top of Rail on R.R. Deck
Snatch Block
Traveler Bents are supported on Blocking, which is not shown
Top of Rail on Traveler Tracks
Traveler Sills and Hoisting Engines are shored, to prevent Horizontal Movement. Shoring not shown
Lines clamped off after preliminary Strain is applied
(Falsework)
Six Sheave Steel Blocks
Counterweight of Steel Girders
Lines Leading around Pier and up on other Side
Water Line Aug. 19th 1911
Pier 4
ENG. NEWS.

FIG. 11. METHOD OF ERECTING THE BENTS OF THE MAIN TRAVELER

TABLE III. MEASUREMENTS FOR THE ERECTION OF THE MUNICIPAL BRIDGE AT ST. LOUIS, MO.

Span	Plan Dimension*		Sag Measurement		Supported Measurement	
	Ft.	In.	Ft.	In.	Ft.	In.
East	672	6	672	6	672	6
Middle	677	0	676	10	676	10
West	672	6	672	7	...	...
Total	2022	0	2021	11		

*Centers of piers.

In order to detect and keep track of any movement of the falsework, lines and levels were taken on same at frequent intervals. The center of each bent was established with a transit, shortly after the bent was placed in position, and these centers were referred to the bridge tangent or center line of bridge at least once a week, and daily when occasion demanded it. Any movement of the falsework, either up or down stream could thus be detected. At the same time levels were run on the ends of the railway-floor beams, in order to detect any settlement which might occur. This movement might be caused by the force of the current on the bents, or by the scouring of the river bed.

The bed of the Mississippi is composed of fine sand and silt, which is constantly shifting, due to the action of the current.

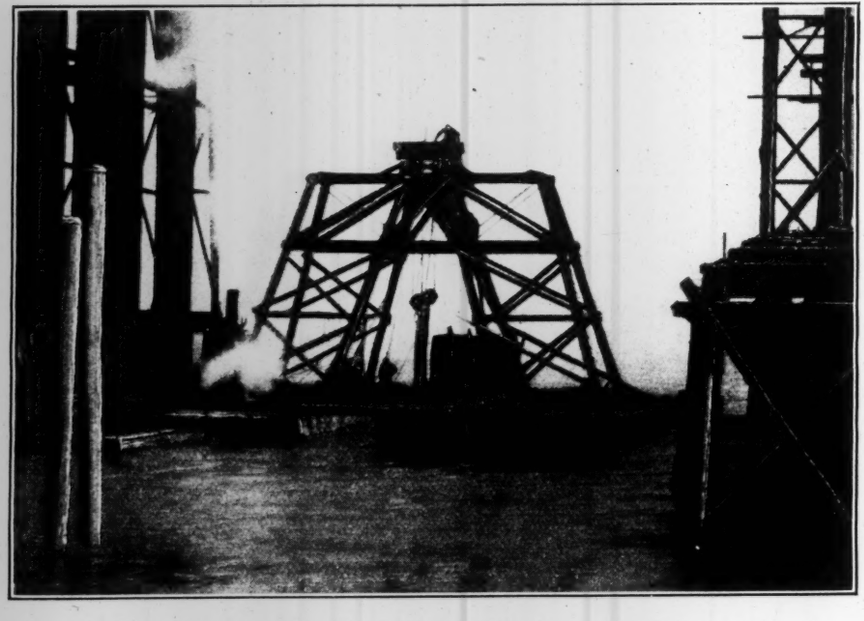


FIG. 12. PILE-PULLING BOAT USED IN REMOVING THE FALSEWORK

The piles of the falsework were driven as deep into the river bed as circumstances would permit, but there was always danger that they might be undermined and washed out by the action of the current, which at this point sometimes reaches a velocity of 8 m.p.h. In order to guard against such a disaster, soundings were taken at least once a week (and daily in the east span) during periods of comparatively high water. These soundings were taken at the two ends and middle of each bent; they were plotted on a tracing which shows a cross-section at each bent, the position of the river bed and the penetration of each pile at the time of driving.

The penetration of any pile at any particular time was thus shown graphically, as well as the fill or scour at any bent since the preceding soundings were made. It was not at all unusual to find a fill or scour of 5 or 6 ft. within 24 hours. These soundings were usually made with an ordinary sounding line and lead. But during a rise of the river, when the depth in the east span exceeded 60 ft. at some points, this method was found to be inadequate, owing to the swiftness of the current. In place of the sounding line, an annealed wire was then used. This wire was wound on a reel and had markers at 5-ft. intervals. A piece of wrought-iron pipe filled with lead and weighing about 30 lb. was used as a weight. This apparatus required two or more men to handle it, but gave reliable results. Much trouble was experienced from the line or weight fouling on submerged drift or on the submarine bracing.

During the erection of the east span and after the middle panel was erected, the river began to rise, bringing down large quantities of drift, ranging in size from brush to logs 2 ft. or more in diameter and 50 ft. or so in length. This drift lodged against the falsework and accumulated in spite of the effects of the river crew to dislodge it. The force of men employed on this work was then increased and night and day shifts were employed. The larger snags were handled by means of a floating derrick and by runner lines leading from the pile-driver barges and from the "mule" on top of the falsework. The accumulated mass of drift was gradually disposed of and the new drift was kept under control. The river meanwhile continued to rise until a stage of 19 ft. was reached. Daily soundings showed that the deep water was gradually shifting toward the west. The river bed in the west half of the east span and for about 100 ft. west of Pier III scoured to such an extent that some of the shorter piles worked loose and washed out. The bents were temporarily braced with timber-sash braces until more piles could be driven.

The vibration of the falsework at this time was very marked. The tops of some of the bents near Pier III were pushed

downstream over a foot by the pressure of the current. In order to stop the scouring of the river bed and prevent the possible loss of the falsework and partially erected span, rip-rap and sacks of sand were then dumped between the two rows of piles forming the bent. This material was wheeled from barges and dumped near the upstream side of the falsework, with the expectation that it would reach the bottom at or near the downstream side of same. It was found by tests that single sacks would not come to rest on the river bed within a reasonable distance, but would roll down stream almost indefinitely. Several sacks were, therefore, tied together and dumped at the same time. The rock was thrown in loose. In all, about a dozen barge loads of rip-rap and 7000 or 8000 sacks of sand were used. In spite of this, the scour continued for some time, and was barely held in check until a fortunate fall of the river relieved the situation.

During the first part of this period of high water, the east half of the span was being erected. This part of the work was completed and bolted up, at about the time the crest of the rise was reached. In view of the condition of the west half of the falsework, it was not thought safe to erect the remainder of the span until the water fell sufficiently to allow additional piles to be driven at the weak points and the falsework generally reinforced. As the water fell, the falsework came partly back to proper line. The railway-floor system was then jacked back the remainder of the way, so as to be in the proper position, and erection was resumed after a delay of about two weeks. No trouble was experienced in completing the span, and the last pin of the east span was driven on Oct. 26.

The work of lowering the camber blocking was immediately begun, and continued for several days. The blocking was bored out by means of pneumatic boring machines and split out by chisel bars and sledges. The blocking at the sub-panel points was first lowered, then the No. 2 and No. 4 points at the west end of the span were let down, so as to hold the fixed shoes in position. The remainder of the blocking was then lowered, beginning at the east, so as to cause the camber movement to take place in that direction.

The segmental expansion rollers which are at the east end of each span were adjusted just before the span was lowered onto them. These rollers were adjusted to stand vertically under dead load at normal temperature, 62° F. Owing to the great weight of the span, some of the camber blocking was exceedingly difficult to remove, and heavy pressures were thrown on some of the last points to be lowered. As a result of this pressure, the bottom lateral plates at these points became badly dished and were straightened later with considerable difficulty, by means of jacks and wedges. In view of this fact, a different arrangement of the camber blocking was used at the secondary points of the next span and sand jacks were placed under the principal points so as to control the lowering of the span more readily.

As soon as the span was swung, the work of removing the falsework was started. The timber bents were disconnected and lowered into the water in quarter sections, by a stationary hoisting engine on the railway deck of the bridge. These sections were then towed downstream and beached just south of the Pittsburg dike, where they were left until used again in the west span. For pulling the piles, a heavy timber tower formed of two bents battered in both directions, was constructed on two barges, as shown in Fig. 12. These barges were placed about 10 ft. apart in the clear so as to straddle the double line of piles forming the bent. Two sets of falls, composed of 4-sheave steel blocks, reeved with wire rope, were used and attached to the pile by means of chains. After the pile was lifted about 20 ft. by the main falls, they were disconnected and the pile lifted clear by means of a runner passing through a snatch block attached to the lower chord of the span. From 30 to 45 piles per day of 9 hours were pulled with this rig.

After the piles were pulled, the channel was dragged to be sure that no obstructions were left that might interfere with navigation. For this purpose two pile drivers were lashed together, with space between for a tug. In the leads of each driver, a pile was suspended and a heavy timber was bolted to the bottom of each pile, thus connecting them to each other. The piles with the horizontal connecting timber were then lowered to the desired depth below the water surface, and the tug towed the drivers up and down stream over the site of each bent. Any broken piles found were removed by dynamite. The work of dragging the channel was done in the presence of a representative of the local office of the War Department.

The work of erecting the west and last span was rendered difficult and dangerous by the cold weather and the heavy ice in the river.

In order to protect the west span falsework from floating ice, clumps of three piles each were driven about 50 ft. c. to c. arranged on a line running from the nose of Pier II upstream and toward the west bank of the river. This line of pile clusters made an angle of about 60° with the center line of the bridge. A boom composed of two piles lashed side by side was attached to the pile clusters by means of wire ropes, so that the boom could rise or fall with the river. The first floating ice appeared in the river late in November, but was not heavy enough to cause trouble. As the weather grew colder, the water between the boom and the falsework froze over, and a belt of ice formed outside of the boom. This served to deflect the floating ice into the middle span, through which it passed without doing any harm.

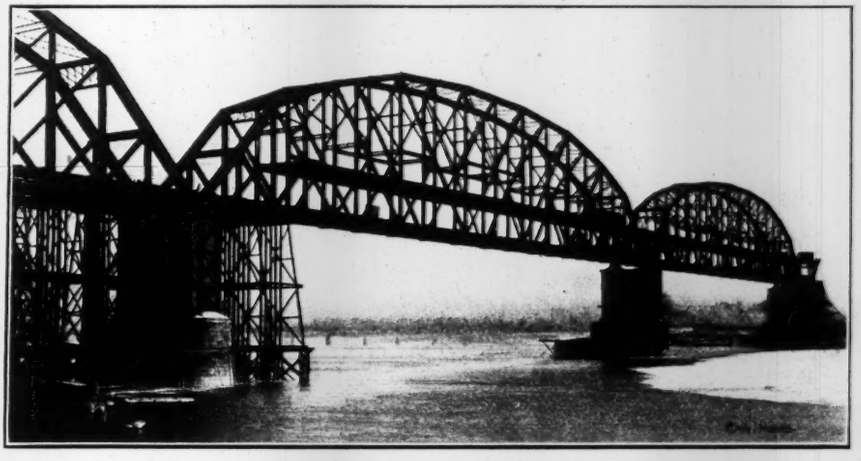


FIG. 13. COMPLETED EAST SPANS OF MUNICIPAL BRIDGE, AT ST. LOUIS
(From a photograph taken about the middle of January.)

In order to provide for the possibility of the falsework between the pier and the shore being swept out, bent No. 6 west was made sufficiently strong to carry the weight of the span from Pier II to this bent. The dead load stresses in the trusses were computed, assuming the span to be supported on Pier II and Bent No. 6 west. Under these conditions, members U6-M7 east, composed of eye-bars, were in compression. The eye-bars were accordingly stiffened by means of timbers bolted between them, and the members were braced together by diagonal rods and transverse timber struts. As soon as the trusses and bracing were completed to panel point No. 6 west, the camber blocking at the sub-panel points 1, 3, 5, 7, etc., was removed, and the weight of the span carried on the sand jacks at the principal panel points 2, 4, 6, 8, etc. With this arrangement, in case

TABLE IV. PROGRESS RECORD OF ERECTION OF THE RIVER SPANS OF THE MUNICIPAL BRIDGE AT ST. LOUIS; 1911-'12

	East span	Middle span	West span
Began pile driving	May 9, 1911	July 18, 1911	Nov. 23, 1911
Finished pile driving	June 22, 1911	Aug. 5, 1911	Dec. 31, 1911
Finished falsework	Sept. 13, 1911	Oct. 26, 1911	Jan. 20, 1911
Began erecting trusses	Sept. 11, 1911	Oct. 28, 1911	Dec. 20, 1911
Finished erecting trusses and bracing	Oct. 27, 1911	Dec. 6, 1911	Jan. 24, 1912
Channel cleared	Nov. 21, 1911		

of any danger to the falsework in the river the span could be swung between Pier II and bent No. 6 west in a short time. Bent No. 6 west was on the shore above any ordinary stage of the river.

Early in January very cold weather occurred, which lasted about two weeks. During this time the river at the bridge site froze entirely over. This cold spell was followed by a thaw and on Jan. 20 the ice immediately below the bridge went out and that above moved sufficiently to destroy the fender, break about twenty piles of the west-span falsework, and take out four bents of piles just west of Pier III, which had not been pulled because of the ice. After this the ice held for several days.

The sand jacks at points No. 2, at the east end of the span were lowered, leaving points 1, 2 and 3 clear of the blocking; the falsework near Pier II was unbolted and work was pushed on the steelwork for the west end of the span, which at that time was incomplete from panel point No. 6 west to Pier I.

The last pin was driven a few minutes before midnight of Jan. 23, and the last of the bracing for the truss steel was placed the following morning, Jan. 24. The remainder of the camber blocking was then removed, the sand jacks lowered and the span finally swung on Jan. 25, shortly before midnight. On the following day, Jan. 26, the ice was broken up by the tugs in the harbor, and the greater part of it between the Municipal and Eads bridges went out, passing between the east and middle spans, without doing any damage worth mentioning.

The floe above the west span fortunately pivoted on Pier II and swung over against the west bank, where it remained.

The progress of the work on the span is shown in Table IV. It is to be remembered that about two weeks' time was lost in the erection of the steelwork of the east span, and of the falsework of the middle span, due to the rise of the river, mentioned above. The east span has been cleared of falsework, leaving a clear channel. The middle span is practically cleared, and the work of removing the falsework of the west span has begun. The east and middle spans are being riveted, and the highway-floor system of these two spans is nearly all in place.

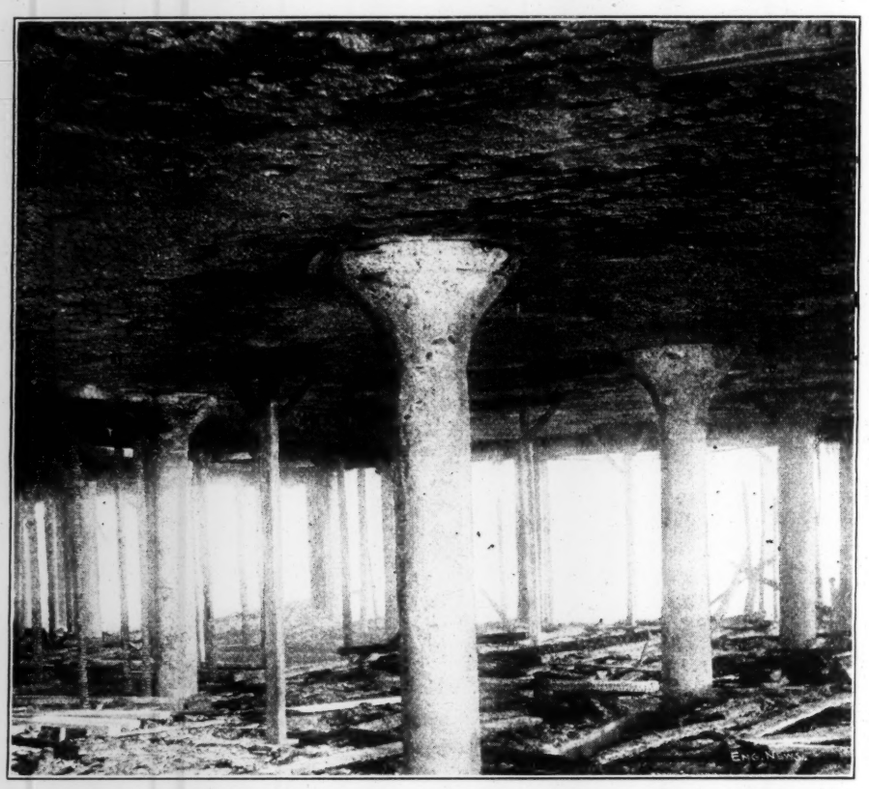
The falsework, hoisting trestles and travelers were designed and built by the American Bridge Co., the superstructure contractor, which also devised the general scheme of erection and the erection methods. This company was represented in the field by W. H. Radcliffe, erecting engineer, and Chas. Webster, general foreman.

The bridge and approaches were designed by and are under the supervision of Boller & Hodge (now Boller, Hodge & Baird), consulting engineers, of New York. Local matters are looked after by Brenneke & Fay, resident engineers, of St. Louis, while the writer is engineer-in-charge, representing the last-named firm.

A Radical View of the Sewage Works question was expressed in a paper recently read before the Manchester section of the Society of Chemical Industry (England) by Dr. Grossman, of Manchester. After speaking of the enormous (theoretical) value of the manurial constituents of sewage works, which he claims total about $200,000,000 (presumably for all of Great Britain), the author of the paper expresses the belief that sewage sludge, unless disposed of by "sound hygienic" methods, is a source of danger to the community. He also said that no process of sludge disposal can be considered satisfactory which does not make it possible to return to the soil the manurial constituents of the original sewage in a thoroughly sterilized condition. Sludge cannot be used as a valuable fertilizer unless it is free from the greasy matter which it contains, for greasy matter prevents the assimilation by plants of the manurial constituents of the sewage sludge.

A Fire in a Concrete Building under Constuction

The accompanying halftone is a view of the second floor of the Swift-Canadian Co.'s building at Fort William, Ont., taken after a fire, on Dec. 15, 1911, that completely burned out the centering and falsework supporting the second and third floors of the building, then under construction. The concreting was being carried on through the very cold weather common in that part of Canada in December and the usual precautions for heating the interior of the building and the concrete were observed. On Dec. 7 the columns supporting the top floor, shown in the view, and the top floor slab were cast, this being the last concrete work to be done. Salamanders were kept lighted in the two floors thereafter to preserve a high temperature for the setting concrete, and on Dec. 15, eight days after the last concrete was laid, a pot of pitch caught fire from one of these salamanders and the whole timbering was soon destroyed.



A FLOOR OF A CONCRETE BUILDING AFTER A FIRE WHICH BURNED OUT ALL OF THE FALSEWORK

The concrete was damaged only by a slight surface spalling and the slabs and columns stood up under their load without any apparent crack or sag, although the concrete had had only about eight days' set in very cold weather.

The building was designed by C. A. P. Turner, using the Turner system of "mushroom" flat-slab construction, and was built by J. & W. A. Elliott Co.

Treating Seasoned vs. Unseasoned Ties*

By F. J. Angier†

By an unseasoned tie, we mean one freshly cut; or, at least, one that has been recently cut and has lost but a very small amount of the moisture which it originally contained. In other words, the sapwood is so completely filled with moisture that it would be impossible to thoroughly treat the tie until this moisture had been at least partially removed. A seasoned tie, therefore, is one that has been cut for some time and the moisture allowed to evaporate to a greater or less degree.

The time necessary to season a tie so that it can be properly treated varies in different localities, as well as in different seasons. The kind of wood also is of considerable importance. Oak ties, in Illinois, must be air-seasoned six months or more (according to the time of year) before they can be properly treated. Some kinds of ties may be seasoned in three or four months.

We will assume that it requires six hours to treat a charge of thoroughly seasoned ties and nine hours to treat a charge of unseasoned ties. In other words, it requires 50% longer to treat unseasoned ties. Of course, the time may vary one way or the other, but we found this to be a fair average. The treatment referred to is with a mixture of creosote and zinc-chloride, known as the Card process.

Assuming this to be correct, attention is called to Table I, showing the cost of treating in a plant having a maximum capacity of 1,800,000 seasoned ties a year, and the cost of treating in the same plant when the maximum capacity is reduced to 1,200,000 unseasoned ties a year.

In each case the total cost of handling is shown from the moment the ties are received at the plant until they are loaded into cars for shipment. In fixed expenses are included the salaries of the superintendent, general foreman, office force, enginemen, firemen, etc.; that is, all labor which would not change one way or the other, whether treating seasoned or unseasoned ties. This amounts to $0.0129 per tie when treating 1,800,000 ties per year, and $0.0194 when treating 1,200,000 ties per year.

In the case of seasoned ties, where no steaming is done, it is assumed that insurance is carried on 1,000,000 ties for six months and that $250,000 will be continually invested at 5%. In the case of unseasoned ties, we must assume that at least 300,000 will always be in the yard. This stock is necessary to provide against delay to plant at certain times of the year, when traffic is so great that company material cannot be moved with regularity. Also, at certain times of the year, ties will be received faster than they can be treated, necessitating the storing of a portion of them.

TABLE I. COMPARATIVE COST OF TREATING SEASONED AND UNSEASONED TIES

A. Seasoned Ties: 1,800,000 per year	
Unloading from cars to ground to season at $0.0070	$12,600
Loading from ground to trams at $0.0055	9,900
Switching trams at $0.0020 per tie	3,600
Loading treated ties out at $0.0065 each	11,700
Fixed expenses	23,268
Preservatives at 15c. per tie	270,000
Fuel (assume 33⅓% less for seasoned over unseasoned ties)	5,600
Insurance carried on 1,000,000 ties (estimated)	4,000
Interest on 1,000,000 ties for 6 months, or 5% on $250,000	12,500
	$353,168
600,000 more seasoned ties treated than unseasoned, worth $0.044 each (see statement)	26,400
	$326,768
Cost per tie $0.1815	
B. Unseasoned Ties: 1,200,000 per year	
Unloading 25% from cars to ground to enable prompt releasing of cars, at $0.0070	$2,100
Loading 900,000 ties from cars to trams at platform and 300,000 ties from ground to trams at $0.0055	6,600
Switching 300,000 ties from yard to retorts at $0.0020	600
Loading treated ties out at $0.0065 each	7,800
Fixed expenses	23,268
Preservatives at 15c. per tie	180,000
Fuel	8,400
Insurance carried on 300,000 ties (estimated)	1,200
Interest on 300,000 ties, or 5% on $75,000	3,750
	$233,718
Cost per tie $0.1948	

TABLE II. COMPARATIVE VALUES OF TREATED AND UNTREATED TIES

A. Untreated Ties	
First cost	$0.50
Cost of putting in track	0.15
Cost of tie in track	$0.65
5% interest on investment for six years	0.195
Second renewal, end of six years.	0.65
5% interest on first investment for six years, and on second investment for six years	0.39
Total cost of tie for 12 years	$1.885
Average cost per tie per year	0.157
B. Treated Ties	
First cost	$0.70
Cost of putting in track	0.15
Cost of tie in track	$0.85
5% on investment for 12 years	0.51
Total cost of tie for 12 years	$1.36
Average cost per tie per year	$0.113
Saving per tie per year	$0.044.

It is shown in the table that a treated tie is worth $0.044 to the company. This is obtained as shown in Table II. Untreated ties are assumed to last six years, and treated ties 12 years.

Assuming this to be reasonable, and that 600,000 more ties per year can be treated when thoroughly seasoned, deduct from the cost of seasoned ties the difference between 1,800,000 ties and 1,200,000 ties (or 600,000 ties) at $0.044 each. We have a difference of $0.0133 per tie in favor of treating seasoned ties. This multiplied by 1,800,000, the number of seasoned ties treated per year, represents a saving of $23,940 in favor of seasoned ties.

In addition there would be a better penetration of the preservatives; therefore, a longer life obtained for the ties and the lessened possibility of injury to the wood by steaming. When steaming there is always a large amount of sewage to dispose of, while in nonsteaming there is practically none. The disposition of sewage is a difficult problem at most plants, because no matter how it is handled some of it will get into the rivers or creeks and pollute the water to such an extent that damage suits may result. This is entirely avoided when using seasoned ties.

*Abstract of a paper presented at the annual meeting of the Wood Preservers' Association, at Chicago, Jan. 16, 18.

†Superintendent of Timber Preservation, Baltimore & Ohio R.R., Baltimore, Md.

Municipal Regulation of the Heating. ventilation, cleaning and disinfection of street cars in several cities of the United States is set forth by extracts from municipal ordinances published in "Public Health Reports" of the United States Public Health and Marine-Hospital Service for Dec. 29, 1911. We quote from several ordinances as follows:

PITTSBURG, PENN.—All companies or corporations operating street passenger railway cars in the city of Pittsburg are hereby required to cause each car in regular use on said street railways to be thoroughly cleansed and fumigated inside with disinfectants, at least once each week, under the supervision of inspectors assigned for said purpose by the director of the department of public health. (Ordinance adopted July 28, 1910.)

READING, PENN.—All street-railway cars operated within the city of Reading shall be heated whenever the temperature is lower than 50° F.; all cars to be equipped with standard Fahrenheit thermometers in good order, securely fastened to the wall of the car, near the center thereof, on the opposite side from the stove or heater, if there be one, and so placed as to give the average temperature of each car and be conveniently visible for examination by the passengers thereon. All cars shall be kept clean, disinfected, and so ventilated as to be free from foul or vitiated air. (Regulation, board of health, adopted May 15, 1911.)

SYRACUSE, N. Y.—All passenger cars operated on any street-surface railroad in the city shall hereafter be equipped with movable floor gratings or other suitable devices, so that the floors of the cars shall be properly cleaned. All cars shall be cleaned daily throughout when used and shall be properly heated and ventilated; and the commissioner shall make such other and further regulations relating thereto as he may deem necessary. (Ordinance adopted Mar. 27, 1911.)

TRENTON, N. J.—That each and every railway car running through or upon the streets of or elsewhere in the city of Trenton and engaged in carrying passengers in said city or to other places shall be kept carefully and thoroughly washed and cleaned and, when so directed by this board, fumigated, so that all filth and dirt or causes of diseases are removed from the inside of said car. That every person or corporation engaged in the running or operating of a line of railway cars through or upon the streets of or elsewhere in the city of Trenton shall have and provide for the use of the passengers desiring to ride therein cars which are entirely inclosed and properly heated whenever the state of the temperature or of the elements requires the same or whenever in the judgment of the board of health the same may be necessary for the proper preservation of the health of the inhabitants of the city of Trenton, and to be heated to a temperature of 65°. (Art. 1, sanitary code adopted Aug. 1, 1910.)

Pollution of the River Tame*

By John D. Watson†

The pollution of this British river by the sewage and trade wastes of Birmingham and vicinity, the immense sewage farm, and the elaborate system of settling tanks and percolating filters established subsequently are described. In conclusion, a rational view of sewage disposal and stream pollution is presented.

*Condensed from a paper sent to the National Association for Preventing the Pollution of Rivers and Waterways of the United States, Baltimore, Md., December, 1911.

†Chief Engineer, Birmingham, Tame and Rea District Drainage Board, Birmingham, England.

The author proposes to give a short description of a river in England, which, by reason of the great development of trade, had become an exceptionally foul stream, particularly during the latter part of the nineties.

In consequence of the construction of sewage-purification works, costing in round figures about £2,000,000 [$10,000,000] the river has enormously improved during recent years, and now gives rise to the hope that it may before long be able to sustain fish life, having already become rich in vegetable growth, and acceptable as drinking water for horses and cattle.

The river referred to is the Tame, which rises in the middle of England, near the southern extremity of the South Staffordshire coal fields, at an elevation of about 600 ft. above sea level. The area of the watershed above Tamworth (see Fig. 1) is approximately 385 sq.mi.

Above the [sewage-purification] works of the Birmingham, Tame and Rea District Drainage Board at Saltley, the Tame is burdened with polluting matter from dwellings, factories and every kind of property pertaining to an industrial community. Even in the short distance before this stream reaches the City of Birmingham—a distance of 12 miles—it is laden with pollution from 15 different townships, which have an aggregate population of over 400,000 persons.

The volume of the stream, which we dignify by the name of river, is small, only a few yards wide until it reaches Birmingham. The average measurement of the flow taken in wet and dry weather (excluding floods) at Saltley is 2590 cu.ft. per minute, and this is made up of three streams (see Fig. 1):

The Tame above Hockley Brook.....	1922 cu.ft. per min.
Hockley Brook before it joins the Tame..	149 cu.ft. per min.
The Rea before it joins the Tame....	519 cu.ft. per min.
Total	2590 cu.ft. per min.

The population of the watershed above the Drainage Board's works is now (1911) upward of 1,311,000 persons, and there are 950,000 persons within the Drainage Board district. If 30 gal. [36 U. S. gal.] be reckoned as the amount of sewage per head, it is seen that the volume of sewage to be treated by the Drainage Board exceeds the volume of water in the river at Saltley by nearly 5,000,000 gal. [6,000,000 U. S. gal.] per day.

The trades' waste to be found in the Tame and its tributaries above Bescot is largely metalliferous in character, combined with large quantities of spent liquor from galvanizing works. This manufacturing waste acting upon the sewage which formerly (1898) reached the streams induced what might be termed mutual precitipation; especially was this so where the river was sluggish, owing to the existence of a weir or pool attached to a work, or where there was a depression in the bed of the stream. This is well illustrated by the analyses of samples taken below and above Elwell's pool:

	Parts per 100,000 Suspended solids	Oxygen absorbed
Above	17.5	19.83
Below	2.3	6.18

When the pool was undergoing its periodical flushing, the results were:

Suspended solids..313.0 parts per 100,000
Oxgen absorbed... 10.78 parts per 100,000

The nature of the pollution, as well as the conditions, are different on the Rea; there the pollution during dry weather is much less, but on the other hand, during wet weather, is very great.

The peculiar nature of the pollution in the Tame, and its fairly constant flow, account for the rapid purification of the river in dry weather.

The natural recuperative influences at work in an impure flowing stream, observed by Pettenkofer, Frankland and Schenk, account for much, but here those influences are enormously increased by chemical action; it accounts for the foul state of the river in time of flood when the bed is scoured of all its slime and

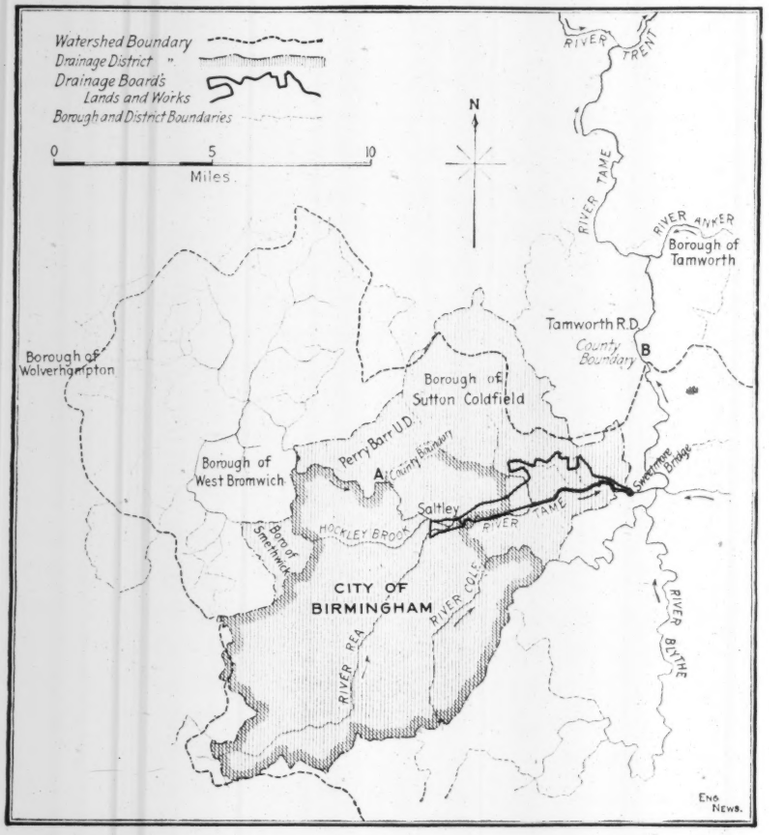


FIG. 1. MAP OF PORTION OF THE WATERSHED OF THE RIVER TAME, ENGLAND, SHOWING BIRMINGHAM, TAME AND REA DRAINAGE AND SEWERAGE DISTRICT AND SITE OF SEWAGE DISPOSAL WORKS

silt. This is well illustrated by the following analyses:

	Parts per 100,000 Oxygen absorbed
Dry weather:	
River Rea at Saltley..	0.913
River Tame at Saltley	1.172
River Tame at Sweetmore Bridge.....	1.233
Flood:	
River Rea at Saltley..	6.993
River Tame at Saltley	6.279
River Tame at Sweetmore Bridge	6.399

One of the interesting factors in considering the vicissitudes of this stream is the fact that at Sweetmore Bridge it is augmented by a volume of water equal to its own bulk, artificially imported, so to speak, from another watershed. This great body of water is the effluent from the Drainage Board's works, consisting chiefly of water which was impounded in Wales, conveyed to Birmingham, a distance of 80 miles, used as potable water, fouled, and afterward subjected to a purifying process and discharged into the valley of the Tame.

It may be assumed that prior to 1898, very little had been done to prevent the pollution of the river. Dr. Reid, Medical Officer of Health for the County of Stafford, to whose zeal so much is due, stirred up all the authorities responsible for the condition of the river as it reentered Staffordshire near Tamworth, with the result that one after another, beginning with the Drainage Board, has constructed works of sewage purification. The effect of this work on the condition of the river is seen by Dr. Reid's diagram showing year after year the diminution of albuminoid ammonia, and the equally steady increase of nitric nitrogen in the river.

The Town Council of Birmingham was respontible for the discharge of inefficiently purified sewage into the rivers until the creation of the Drainage Board in 1876. In that year Birmingham and several other towns in the immediate vicinity were united to form one authority for sewerage and sewage disposal, and this authority found at Saltley several precipitation tanks and 80 acres of land available for a population of 600,000 persons.

The farm and works were added to from time to time until, in 1895, the Drainage Board owned a farm of 1792 acres. Still too small for the work of purifying the sewage of the district, 1038 additional acres were acquired—chiefly under compulsory powers obtained by an Act of Parliament in 1897—thus constituting the third largest sewage farm in Europe. Not satisfied that even this great extension of the sewage farm would accomplish what the Drainage Board's advisers expected, the Town Council of Tamworth applied in 1898 for an injunction to restrain the Board from polluting the river. The injunction was not then granted, but the court made an order appointing the late W. Santo Crimp to report whether the proposed extension of the sewage farm was sufficient to meet obvious requirements. Mr. Crimp gave it as his opinion that the works as proposed were not sufficient, and suggested certain additional works, which were afterward executed at a cost of upward of £100,000 [$500,000].

The clamor of the Tamworth authority, in conjunction with the advance of public opinion, may be said to be responsible for the large extension of the sewage farm, and the works recommended by Mr. Crimp. The awe of the Court of Chancery was probably responsible for the regrettable diligence with which the work was carried out—regrettable because it was at this very time that a Royal Commission was appointed to inquire whether it was possible to purify sewage without resorting to land. The Commission appointed in 1898 issued a preliminary report in 1902, in which they stated:

> After carefully considering the whole of the evidence, together with the results of our own work, we are satisfied that it is practicable to produce by artificial processes alone, either from sewage, or from certain mixtures of sewage and trade refuse * * * * effluents which will not putrefy, which would be classed as good according to ordinary chemical standards, and which might be discharged into a stream without fear of creating a nuisance.

It became apparent to the author before 1902 that 2830 acres of land were not nearly adequate to purify the sewage of so great a district as that for which the Drainage Board was responsible, and in the spring of 1903 the Board instructed him to construct several bacteria beds on more permanent lines than the experimental beds which had been at work for the previous two or three years. The excellent effluents obtained, the large quantity of sewage purified on the limited area of the bacteria beds as compared with land, and the obviously hygienic advantages possessed by those beds, together with the fact that for irrigation it was necessary to buy and lay out nearly one and a half acres of land every week in order to keep pace with the increasing population, all contributed to induce the Drainage Board to advance along the lines of biological treatment; and this notwithstanding the fact that the works sanctioned by Parliament in 1897 were all but completed.

The Drainage Board, acting upon the author's advice, have since constructed a biological plant, including upward of 56 acres of bacteria beds (an installment of 67 acres) storm-water tanks, sludge-disposal works, etc., at an actual total cost, exclusive of land, of nearly £400,000 [$1,950,000]. This has been done, not because they regard the principle of purification by land irrigation as bad in itself, nor because they were dissatisfied with any part of the engineering works required to utilize the land for that purpose; but because they felt it to be their duty, as representing the public, to see that their works were made as good as it was possible to make them in the light of modern discoveries, even though it was necessary to superimpose a new work upon one which had so recently been characterized as the best available.

During the time when the works of the Drainage Board were under construction, the Tamworth authorities, acting through the Attorney-General, pressed forward their action, and it came to trial in 1907.*

Anomalous as it may seem, the judg-

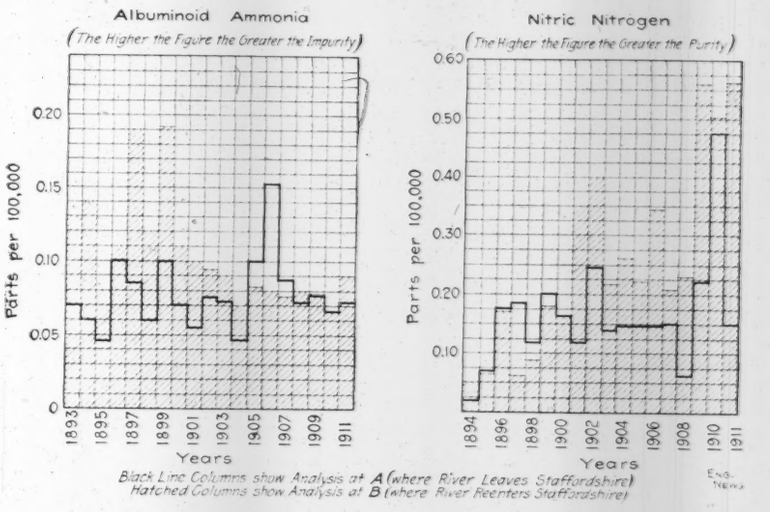


FIG. 2. DIAGRAMS SHOWING ALBUMINOID AMMONIA AND NITRIC NITROGEN IN RIVER TAME, ENGLAND, AT POINTS WHERE RIVER LEAVES AND RE-ENTERS STAFFORDSHIRE CO. (SEE POINTS A AND B, ON MAP, FIG. 1).

(Original diagrams prepared by Dr. George Reid, Medical Officer of Health for Stafford Co., England.)

*The lower court granted an injunction, but the Court of Appeal set aside the injunction. An article giving the decision on appeal appeared in Engineering News for April 21, 1910, p. 462. The gist of this decision was that the effluent from the sewage works was better than the stream into which it was being discharged, and that in view of this, and of the diligence shown by the district and the money spent in building and remodeling purification works, the injunction ought not to stand.—Editor.

ment of the Court of Appeal in England is liable to be appealed to the House of Lords, and just before the year allowed for appeal expired, Tamworth intimated that they were to carry the case to the higher court, and for three days in June, 1911, the question as to whether the Court of Appeal acted within its rights in setting aside an injunction was debated. The judgment has not yet been given, so that the litigation is still inconclusive after 11 years.

Whether a local authority like Tamworth, supported by the rural district of Tamworth, is justified in wasting so much money in litigation as this case has cost is extremely doubtful. No doubt their action has pressed forward remedial measures more quickly than would otherwise have been the case, but the haste has been precipitate and costly. For example, W. Santo Crimp reported to the court that storm-water filters should be constructed at Saltley: they were constructed at a cost of £50,000 [$250,000]. A few years after the Royal Commission condemned storm-water filters as futile, and recommended instead stand-by tanks. Crimp approved the laying out of land for irrigation, which was done at a cost of £200,000 [$1,000,000], at the very time a Royal Commission was inquiring whether it was necessary to use land, and the work was just complete when the Commission reported that bacteria beds would serve the same purpose. Again, works had to be designed in haste that should have been designed at leisure in order to impress the court with the progress that was being made, and all this took place at the instigation of a local authority which had, up to 1908, done nothing to prevent the sewage of its own district from flowing direct into the Tame without treatment of any kind.

It was this and several other cases of a similarly tantalizing and costly kind that led the Royal Commission on Sewage Disposal to recommend that pollution cases should be taken out of the hands of the courts altogether, and placed in the hands of rivers boards, with an appeal to a central authority.

The fifteen separate townships above the Drainage Board's district have all done good work, and each has had its own troubles in doing that work, but in no case, except West Bromwich, was work begun until the Royal Commission had issued their interim report, and what was of even more importance, their only goad was the rivers authority, whose anxiety was not to spend money for the sake of spending it, but to improve the condition of the river.

Difficulties to be overcome there were in every case, some of them exceptionally trying, but they have been met courageously, and now it can be said that nearly all have completed their works, leaving the rivers authority to deal with manufacturers who claim prescriptive right to turn trades waste into the river.

The author hopes that he has not stated more than is necessary to give one who is a stranger to the locality and the circumstances a reasonable understanding of the difficulties that beset the path of the reformer.

The salient fact today is that the River Tame immediately below the Drainage Board's effluent channel at Sweetmore Bridge [Fig. 1] is in a condition capable of sustaining sedges, irises and other kinds of vegetable growth. It is not by any means a good drinking water, but it is used for watering cattle and horses, and is capable of sustaining fish life, unless where it receives occasional discharges of acid waste, whereas only ten years ago the Drainage Board had to meet claims for poisining cattle, rendering mills unworkable, and fouling water for paper making, but, and this is what disturbs the equanimity of the conscientious worker, it is not as good as it might be, nor as good as we now know how to make it. What, therefore, should be the ideal of the conservators of such a river?

In England and Wales alone the outstanding debt on sewerage and sewage-disposal works at the end of 1908-9 was £41,116,129 [in round numbers, $200,000,000] and the amount levied to pay interest and sinking fund and maintenence charges was £4,690,507, or 3.8% of the local taxation for the year.

If the pockets of the ratepayer were inexhaustible, the question whether a river is as good as it should be would be answered by asking if it was fit to drink —apart from the sentimental standpoint, of course—but those pockets are not inexhaustible, and it is probably less costly to eliminate 93% of the 100% impurity which goes when added to the Welsh water to make Birmingham sewage, than it would be to extract another 5%, and so eliminate 98% of the total impurity.

Bearing in mind such considerations, the conservator is again appealed to for his ideal. He will probably say that every case must be considered on its own merits, and that there must be a strict differentiation between inevitable and preventable pollution. When a district becomes urban, especially when the population is great and the river small, it is obvious that rainfall which sweeps in its course filth from the bed of a stream, or accumulations from courts and alleys of infinitely small particles of organic matter, unnoticeable until they are united by rain water and converted into foul streams, is bound on occasion to pollute the river in a marked degree, but we are bound to admit that it is inevitable.

It is also inevitable that the drainage from arable land should tend to pollute the stream, but such a pollution would only be noticeable if the stream had hitherto been regarded as a fit source of water supply. Intensive cultivation of land and better drainage have already produced instances of what is meant. A remarkable case occurred at Aberdeen recently where the water of the Dee, which was pronounced by the Royal Commission on Rivers Pollution in 1868 to be one of the finest potable waters in the world, was proposed to be discarded in favor of a water supply from the Avon, which takes its rise in the highest mountains of Scotland. The sanction of Parliament was required to substitute the one source of water supply for the other, but so far the Town Council has failed to satisfy Parliament that the proposed expenditure of more than a million pounds sterling was justified.

In the category of preventable pollution, the author would place first, insufficiently purified domestic sewage; second, untreated and noxious trades waste and, third, intentional flushings of mill dams, by which sludge is scoured into streams while they are in their normal condition. An effluent fit to be discharged into a river like the Tame should be obtained naturally by percolation through land or bacteria beds, in contradistinction to chemical clarification. It should be without tendency to putrefy. It should continue to improve when it joins the river, and it should not be burdened with more solid matter than three parts per 100,000. This should apply to three times the dry-weather flow and, as regards the excess flow up to and even beyond six times the dry-weather flow, solids should be extracted and suspended matter in the tank effluent should not exceed six parts per 100,000.

I do not despair of seeing the time when each great river will be dealt with as a whole, when a rivers authority will be held responsible by the government for the entire watershed, and will possess authority to determine what degree of purification should be effected by a town or district at the head of a stream; what degree would be acceptable in respect of a town situated on a wide estuary or on tidal rivers; how much storm water should be treated by urban and rural districts, and by whom the total bill should be paid according to an equitable system of allocation.

In my view, we should aim at obtaining pure rivers, not at compelling one place to do something merely because some other place has been made to do it, and I feel sure we should be much nearer this ideal if a central authority had power to rate a whole watershed and to spend the money where they knew it was most needed.

Riparian owners would be sure to grumble that they were rated for the benefit of the cities, but they ought not to forget that their lands are responsible for a share of the pollution, and that cities, as in the case of Aberdeen, are sometimes compelled to spend great sums of money in order to escape the effects

of a pollution which they are helpless to stop. Besides, riparian owners would probably be benefited by obtaining revenues from fishing, which without the remedial works of the rivers authority would be non-existent.

I do not advocate a mere chimera, for Parliament sanctioned a bill in 1889, promoted on the lines desiderated, at the instigation of the Corporation of Edinburgh. The bill was opposed in both Houses of Parliament by mill owners, but without success, and Parliament passed an act constituting a special board, charged with the duty of preserving the amenities of the water of Leith, and conferring power to rate all owners of property *ex adverso* of the river.

The district under the jurisdiction of this board is a purely arbitrary one, and roughly speaking is about 12 miles long by 3 miles wide. The area is an irregular one, and seems to have been laid down on the plan so as to enable the board to deal with those mills, villages and properties whose refuse and sewage actually flow, or, in the event of extension, naturally would flow into the water of Leith. For the purpose of the act, each of the portions of the landward district within the jurisdiction of the landward local authorities is declared to be a Special Drainage District under the Public Health Acts, and under the powers contained in these acts the respective local authorities may extend and enlarge any such Special Drainage District. The assessable rental of the whole district is nearly £3,000,000 [$14,600,000].

I am glad to see that a similar district has been formed in Germany for a like purpose. The Drainage Board to which I refer is a federation of cities and towns, coal mines, steel and other industries in the valley of the Emscher River, a tributary of the Rhine, with a population in its drainage area of about 2,000,000 persons. The district was formed in 1904, five years after the formation of the Edinburgh Special Board, and the work which is being done under the guidance of the Chief Engineer, Dr. Imhoff, is so remarkable and so excellent that the author is hopeful to see such boards more universal.

Speculative Appropriation of Water power sites in California is described in a report to the State Conservation Commission by its special agent, Horace P. Jones. It is stated that 95% of the water-power locations in the state are made by speculators who have neither the means nor the intention to develop the power.

Development consists largely of trails and cabins built and surveys made. The usual custom is to have one or two men, with a wheelbarrow or a pick and shovel, stay on the ground until it can be ascertained whether or not there is any likelihood of a big company or interest coming onto the ground and buying the right, such as it is. This is the case in a large number of the filings located at strategic points along the Tuolumne River and its tributaries for which the purchase price of $652,000 was paid.

Roman Influence on City Street Plans

By Charles H. Higgins*

Roman law dominates our jurisprudence, our language is full of its words and the Eternal City's influence on engineering is still seen in our masonry structures. But that the influence extends to the layout of an American city and reveals itself in the arrangement of streets, will be a surprise, even to most engineers.

That traces of the typical arrangement of a Roman camp are still found in Europe and Africa in the arrangement of streets of certain towns, has been recognized, notably at Silchester and Carwent in England and in Tringad in Africa. But that it may be seen in America has not, to the writer's knowledge, been understood.

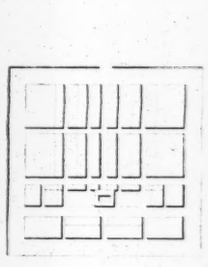


Fig. 1. Typical Plan of Roman Camp

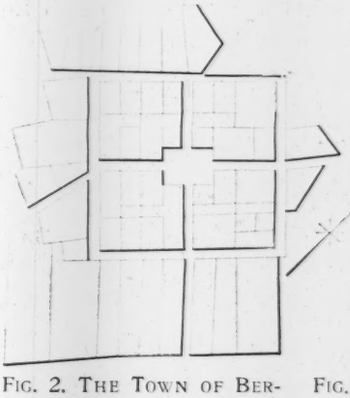


Fig. 2. The Town of Bergen, N. J., as Laid Out in 1764

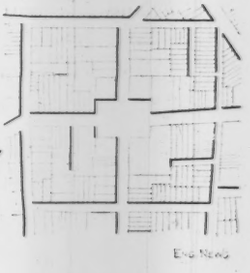


Fig. 3. Lay-out of Property Around Bergen Square, Jersey City, in 1912

The Dutch, in the early part of the seventeenth century, settled at Communipaw and a little later—1660—founded the town of Bergen, on top of the high ridge west of the Hudson River, just south of the present Pennsylvania Railroad cut. This is now a part of Jersey City and the Summit Avenue Station of the Hudson & Manhattan electric line is but a few hundred yards from where these old Dutchmen dug their well and built their stockade, for protection from the Lenni Lenape Indians, in whose country they settled—much as the Romans built their camps in the country of the Gauls and Germans.

By the latter part of the eighteenth century, the English possessed this land. In 1764, commissioners laid out the Town of Bergen and their map has come down to us of this generation.

In Fig. 1, we have a plan of a typical Roman camp, such as Caesar describes and such as the Roman legions built each time they camped in the enemies' territory, if it were for but a night. The four gates, the broad open street inside the *vallum*, which surrounded the camp, the *principia* or main street extending directly from one side gate to another, the street at right angles to this from one end gate through the *forum* to the gate at the other end.

Fig. 2 shows the plan of the commissioners appointed to lay out the Town of Bergen, a plan in great measure determined, we can have no doubt, by the arrangement of the Dutch founders of a century before who had dug their well and built their stockade; and many of whose descendants still live on the spot.

Fig. 3 shows the existing arrangement of streets about what is now known as Bergen Square, Jersey City.

In each of the last two, we find the typical open marginal way or street with its four exits or entrances, the two main thoroughfares connecting these and the open space or forum at the intersection of the streets.

The analogy is so complete that we cannot but picture some old Dutch soldier—a student of Caesar, or at least of the Romans—first arranging the little newborn Town of Bergen, to resist the attack of a savage foe along the line so well proven in the centuries before. And so we have it to-day in the midst of an American city.

*Civil and Consulting Engineer, 15 Exchange Place, Jersey City, N. J.

Public Health, Health Budgets and hospitals are to be studied by a committee recently appointed by the New York Academy of Medicine (17 W. 43d. St., New York City). A donation by Mrs. E. H. Harriman has made it possible to take up these subjects in a thorough-going manner. The committee consists of Dr. Charles L. Dana, Dr. Lindsley Williams and others. It has employed E. H. Corwin to direct the work. Among other things a bureau will be maintained for the collection of facts in regard to public health, sanitation and hygiene. An endeavor will be made to establish active coöperation with all public health activities in the city and keep the medical profession advised on these subjects. Particular attention will be given to assisting various city departments engaged in health and related work to frame their annual budgets. Various studies of hospitals will also be made.

Cost of Concrete Highway Bridges*

By B. H. Piepmeier†

Graphic methods of determining cost of proposed structures are of importance in reducing the time and expense of estimating, and this is particularly true of minor structures which cannot bear a high cost for estimating. This paper describes a method developed by the engineers of the Illinois Highway Commission for estimating the quantities and costs of reinforced-concrete highway bridges of the slab and girder types. The local authorities often call for such figures at short notice, and the diagrams enable them to be given promptly, either from the office or in the field.

*Abstract of a paper presented at the annual meeting of the Illinois Society of Engineers and Surveyors, at the University of Illinois, Champaign, Ill., Jan. 17-19.

†Assistant Engineer, Illinois State Highway Commission, Springfield, Ill.

With the increased interest in concrete bridge work the Illinois Highway Commission has been called upon for engineering assistance more frequently each year, until it is almost impossible to meet all the requests. For this reason a system of standards was devised and all computations tabulated. This greatly improved the office efficiency and made it possible to answer a larger number of requests.

It has been necessary to do considerable figuring to determine the best make-up for a bridge. Frequently a series of small slabs on piers would sum up much cheaper than the larger spans, or the reverse. It is sometimes advisable to compare a steel bridge for the same site. With the curves that were worked out by H. E. Bilger on the cost and the number of cubic yards in substructures for steel

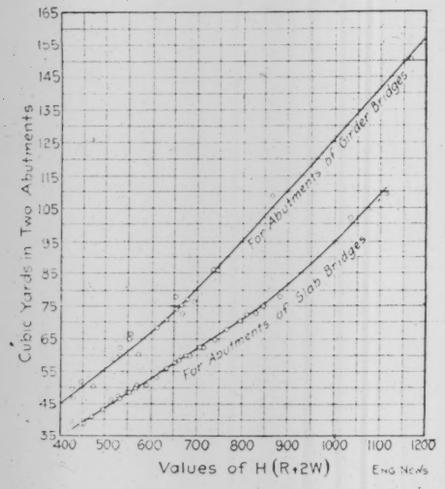


FIG. 1. DIAGRAM SHOWING THE CUBIC CONTENTS OF ABUTMENTS FOR REINFORCED-CONCRETE BRIDGES

bridges,‡ we are able to get a very accurate estimate of the cost of a steel bridge complete. It, therefore, became desirable that some ready means be devised (for both office and field use) for determining the approximate number of cubic yards in concrete slab and girder bridges.

TYPES OF BRIDGES

It may be well to outline the slab and the girder bridges as designed by the Illinois Highway Commission, in order to explain the types of bridges under consideration. For reinforced abutments for slab bridges the main wall is made 12 in. thick from top to bottom, the steel reinforcing being placed on the stream side, and the percentage of steel increased as the height increases. The abutments rest on an 18-in. reinforced footing of sufficient size to allow 3000 lb. per sq.ft. on the foundation. When a soft foundation is encountered, this same size of footing is usually sufficient to permit the proper spacing of the required number of piles. The reinforced wings for slab bridges are of the standard cantilever type, the base being 33% of the total height. The wing wall proper is 12 in. thick for heights up to 16 ft. For greater heights the base of the wall increases in proportion to the height. Nearly all wings for this type of bridge have a drop of 18 in. to 5 ft. at the end to conform to the 1 on 2 slope on the sides of the road. The cantilever type of wing for extreme heights has been found much more satisfactory than the buttress type, as the increased thickness at the base and the large percentage of steel does not equal the extra cost of forming necessary for the buttress type.

Reinforced-concrete slab bridges are designed with roadways from 16 ft. upward. The side rails usually average 8 in. thick and 3½ ft. high. The slab and the side rails come flush with the back of the abutment walls. The top of the wings comes up along the outside of the rails to catch the side slope of the road. In determining the thickness of the slab, its entire dead load is considered, the load of the cushion wearing surface, and a 24-ton engine live load. Excluding temperature stress, the steel is figured at 12,000 lb. per sq.in.; the compression in the concrete is assumed at 800 lb.

For the reinforced abutments for girder bridges, the general type is the same as that for the slab bridges, with the exception that all abutment walls proper are 18 in. thick, and the width of base for the wings is 40% of the total height. The extra thickness in abutments is for bearing of the girders. The extra width of base under the wings is for stability, as the wing walls are cut away from the abutment walls proper by a 1-in. partition to allow for expansion of the superstructure. They can, therefore, receive no support from the abutments, as is the case with wings on slab bridges. The wings come up on the sides of the girders and drop several feet at the ends to follow the general side slopes on the road.

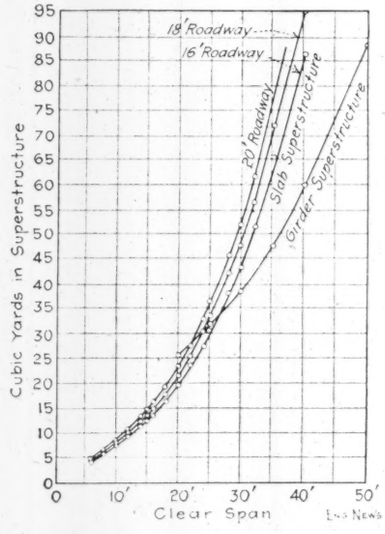


FIG. 2. DIAGRAM SHOWING THE CUBIC CONTENTS OF SUPERSTRUCTURES OF REINFORCED-CONCRETE BRIDGES

The reinforced-concrete girder superstructures* are designed with roadways 16 to 30 ft. wide, but the width usually required is 16 to 20 ft. The side girders average 4 to 6 ft. in height, and 16 to 30 in. wide on the top. On the side girders there are heavy depressed panels to lighten the web and to give the proper appearance to the finished bridge. The floor slab and side girders extend to the back side of the abutment wall. The floor slab is designed to carry the load noted above. The side girders are designed to carry the entire dead load of the superstructure, plus a live load of 125 lb. per sq.ft. on the roadway, or a 24-ton engine, whichever gives the greater moment.

‡Engineering News, Feb. 16, 1911.

*Engineering News, Feb. 10, 1910.

Determination of Quantities

For the purpose of determining offhand the approximate yardage in a pair of reinforced-concrete abutments for either slab or girder bridges, a diagram (Fig. 1) has been prepared. For abutments of slab bridges, 40 different designs were taken from the files of the Commission, and the number of cubic yards in the two abutments of each design was plotted against $H(R + 2W)$: H, distance from finished roadway to bottom of footings; R, clear roadway width; W, length of one wing, measured on the stream side. The clear roadway width is taken for R, as this figure is always secured at the preliminary inspection of the bridge site. The length of the wing, W, can always be assumed in the field or computed in the office, knowing first the general conditions of the bridge site.

It will be noticed that the number of cubic yards in the two abutments varies approximately as the height of the abutments; also, that the maximum deviation from the curve does not exceed 2 cu.yd., and more often it is less than 1 cu.yd. In fact, for heights of abutments up to about 16 ft., or where $H(R + 2W)$ does not exceed 900, the quantities so plotted follow practically a straight line, and might be represented by the straight-line formula, which often times is convenient when the curve sheet is not at hand:

$$\text{Cu.yd.} = 0.09 \times [H(R \times 2W)] - 1.37.$$

Suppose the distance from the crown of finished roadway to bed of stream is 10 ft., and the footing should be carried 4 ft. below bed of stream. Then $H = 14$ ft. Assume the wings are each to be 13½ ft. long, and that the bridge will have a 16-ft. clear roadway. We have now $H(R + 2W) = 600$, the value to be read at the bottom of Fig. 1.

It will be seen by locating the point on the curve and going across to the left-hand side that there are about 53 cu.yd. in the two abutments. Beyond the vertical line at 900, the curve begins to rise above the straight line. This is expected, as abutments exceeding 16 ft. in height have the base of the wings spread to allow for the proper percentage of steel. This extra width of base is added to the back of the wing wall by a batter, the batter extending 4 to 8 ft. above the footing, according to the height of the wall. This batter does not extend to the top of the wall, as the drop at the end of the wing would increase its thickness at the end, and this does not give the best appearance to the finished bridge. The abutment walls remain 12 in. thick up to 21 ft. high, and from here on the thickness increases as the height increases.

The slight variation from the curve in solving specific cases may be attributed to the difference in the angle of the wing with respect to the abutment, and the difference in width of footing for bearing. The more nearly the direction of the wing approaches a parallel with the center line of the road, the higher will be the wing at the end, thereby increasing the number of cubic yards, but as the corner formed by the intersection of the abutment wall and wing is measured twice, these two quantities tend to compensate each other.

For the reinforced abutments of girder superstructures 25 designs were taken from the files of the Commission, and the number of cubic yards in the two abutments plotted as before. The number of cubic yards is somewhat greater than in the abutments for slab bridges. This is due to the extra thickness of the abutment walls proper (to give the desired bearing) and to the extra width of footings under the wings. It will be noted on this curve that some of the specific cases used had a wide variation from the mean. This can be attributed to the fact that some of the abutments had extremely long wings that were level on top, and

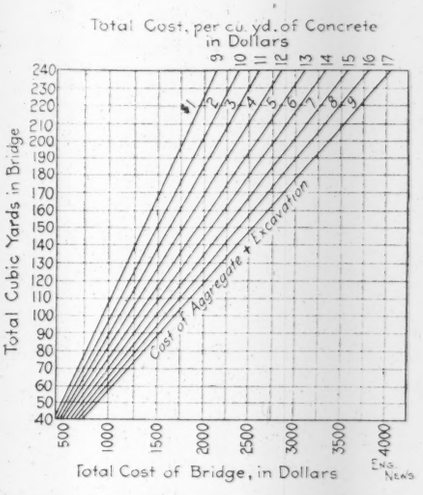

Total Cost, per cu. yd. of Concrete in Dollars
Total Cubic Yards in Bridge
Cost of Aggregate + Excavation
Total Cost of Bridge, in Dollars
Eng. News

Fig. 3. Diagram Showing the Cost of Reinforced-Concrete Bridges

also the different length of spans requires a little different width of footing under abutments to take the required bearing. A curve of this kind could not take into account all of these conditions, and while several points fall several yards off of the curve, the mean is close enough for the purpose that it is to meet.

Taking the same dimensions that were considered before, and reading on the line 600 in Fig. 1, we find that the two abutments contain 67 cu.yd. (instead of 53 cu.yd. for the slab substructure). Thus the diagram is a ready means of comparing the substructures of the two types of concrete bridges.

To determine the quantities in the superstructures of the two types of bridges, the diagram, Fig. 2, has been prepared, and is applicable for the flat-top type of bridges up to 50 ft. span. For slab superstructures, 48 designs of different roadways and spans were taken and the total number of cubic yards in the superstructure was plotted against the clear span length, the curves drawn through the points having 16-ft., 18-ft. and 20-ft. roadway. The three curves will meet the requirements of the majority of highway bridges. Occasionally a special case arises, such as a skew or extra wide roadway, and then it is necessary to make a special computation.

Assume a bridge to have a 30-ft. clear span and 16-ft. roadway; the number of cubic yards is shown to be about 43.2. Consider for the same site the 30-ft. girder type with 16-ft. roadway. The number is about 38.6, or a difference of 4.6 cu.yd. in favor of the girder superstructure. But it will be noticed that for the same height of substructure the difference in all cases is in favor of slab bridges. If it should happen that for a single span the girder bridge and the slab bridge should have the same yardage, an advantage still rests with the slab type, as it has been found that contractors usually bid more favorably on this type. There is also another important point in favor of the slab type. If for any reason there should be any defective material placed in the rail, or poor alignment in its construction, it may be torn down and replaced without disturbing the floor, even after the falsework has been removed.

Determination of Cost

Having found the expression that is the measure of the cubic yards in the abutments and superstructures, the next step is to combine the quantities with unit price that we may determine the approximate cost of each type. For this purpose the diagram, Fig. 3, has been prepared.

It has been found from the cost data of a large number of bridges built under the supervision of the Illinois Highway Commission, that it is possible to get a very close figure on each individual item that goes to make up the cost of the bridge. The items are for one cubic yard of 1:2½:4 concrete. 1, cost (at the bridge site) of sufficient cement for one cubic yard of concrete; 2, cost of lumber for forming for one cubic yard; 3, cost of reinforcing steel per cubic yard; 4, labor cost in mixing and placing one cubic yard; 5, cost of aggregate for one cubic yard; 6, cost per cubic yard of concrete to make the necessary excavation to start the concrete of the footings. The two items that largely control the cost of a structure of this kind are the excavation and the necessary aggregate for the concrete. We find that the cost per cubic yard of concrete for cement, forms, reinforcing steel, and the mixing and placing, have narrow limits of variation.

Therefore, it appears possible that some definite quantities may be fixed to the first four items and a curve plotted

for the last two, combining them in such a way that the total cost may be readily determined after we have learned the number of cubic yards in the bridge.

The cost at the bridge site of sufficient cement to make one cubic yard of concrete for a 1:2½:4 mixture may vary from $1.75 to $2.10. While the price of cement, the distance it has to be hauled, and the amount required for some aggregates, vary slightly, the extreme variation would not be over 20c. per cu.yd from the average. From a general average of cost data it would seem that we are safe in taking $1.90. The cost of forms includes all the necessary falsework, bracing and form lumber. While this item varies somewhat for different localities, and will vary again where the contractor can use some of his old lumber, it will fall between the limits of 75c. and $2.50. Experience has shown that about $1.50 for the ordinary type of bridge is usually sufficient, and might well be chosen for this cost curve.

The reinforcing steel varies from 50 lb. per cu.yd. for substructures to 170 lb. per cu.yd. for superstructures, or an average of about 110 lb. for the two combined. This steel delivered at the bridge site under ordinary conditions and bent ready for placing in the structure will cost about $2.10.

Mixing and placing concrete might vary from $1.50 per cu.yd. for stone-concrete mixed by hand to possibly as low as 40c. for gravel-concrete mixed by machinery. This item should also provide for the necessary work in spading the concrete next to the form and securing the desired finish. In spite of the possible wide variation, we find the cost of this item varies but little from the fixed amount of $1.25. While all these quantities given above may seem somewhat in doubt as to their reliability, experience has determined that they are not far from the correct figures for normal conditions on the average bridge.

The item of excavation, which includes also cribbing, sheet piling, pumping, and all necessary work to start the concreting of the footings, has been found from the cost data on file to vary from 50c. to $5 per cu.yd. of total concrete in the bridge. The 50c. is found only in some very favorable cases, and on the smaller spans, where practically no cribbing, sheeting or pumping is necessary. The $5 cost is caused by a soft, seepy soil where cribbing, sheet piling and excessive pumping are necessary. The wide variation in this item is due frequently to poor management on the part of the foreman in charge. This item, therefore, may vary considerably, but from experience with the excavation that is to be handled and with the type of bridge that is to be built, we can estimate this item sufficiently close for all practical purposes.

It will be seen that the cost of the aggregate delivered to the bridge site is the second item determining the price per cubic yard of concrete. Under the most favorable conditions with respect to location of a satisfactory aggregate supply, it would cost at least 50c. per cu.yd. to haul it to the mixing plant. On the other hand, the cost of aggregate at the bridge site might exceed $4 per cu.yd., as the structure may be isolated from a railway station, and it may be necessary to ship in either gravel or crushed rock and sand, besides hauling it several miles into the country. In the light of the wide range on these two items, Fig. 3 has been prepared to give the total cost of the bridge complete (including profit to the contractor) under conditions where the combined cost of excavation and aggregate at the bridge site might vary from $1 to $9.

Assume that a concrete bridge has 120 cu.yd., as in the one previously determined from the curves. We first investigate the condition of the foundation, and assume the cost for completing this part of the work, and express it as so much per cubic yard of concrete. We then approximate the cost of delivering at the bridge site the necessary aggregate for one cubic yard. Let us say that these two quantities amount to $3. Taking the line for 120 cu.yd., in Fig. 3, and following this across to the $3 curve (or the line for $11 per cu.yd. total cost of concrete, which is the same thing) and then to the bottom of the figure, we find the cost of the bridge complete to be $1300. The total cost per cubic yard of concrete is shown at the top for aid in determining the unit price.

From the figures given, we are able to determine approximately the number of cubic yards in either the slab or the through girder type of bridge, besides having a ready means of determining the probable cost. Similar curves might readily be developed for the deck girder, the through-girder floor beam type, or the arch. This method is not intended to supply a substitute for engineering ability, but rather to furnish an aid that will safely direct the engineer who will interpret with judgment and experience.

A Mallet Locomotive of large size recently built for the Pennsylvania R.R. by the American Locomotive Co., has the special feature of being a simple instead of a compound engine. It has 16 driving wheels of 56 in. in diameter, which are arranged in two groups, with a pair of 27x28-in. cylinders to each group. The weight of engine and tender is about 335 tons, which is 136 tons heavier than the largest freight engines now in service on this road. The total heating surface is 7723 sq.ft., and the steam pressure is only 160 lb. The total length over engine and tender is 98 ft. 4 in. The engine has been built largely as an experiment, and will be tried in freight service on the steep grades of the line in western Pennsylvania.

Proposed Specifications for Hollow Clay Tile Building Blocks

By Virgil G. Marani*

For several years the Building Department of the city of Cleveland, Ohio, has taken an active interest in the subject of the use of hollow clay tile as a substitute for brick in the construction of load-bearing walls. As a result, the conviction has been forced upon the Department that the subject was worthy of careful and thorough investigation. In order to secure all possible data relating to the subject, exhaustive tests were made, by the Building Department direct and also by competent engineers acting in harmony with the Department, and in conjunction with one of its engineers, to determine the strength, stability, fire-resisting qualities, etc., of hollow building tile.

In the crushing tests, a large number of samples were gathered from different places; some from the yards of the manufacturers and some from the sites of buildings under process of erection. A complete range of quality of tile was thus secured and tests made to determine absorbtion and crushing strength. All tile tested were first carefully measured and a complete detailed record kept of each tile throughout the entire test.

Some of the tile were built up into columns of different dimensions and with tile laid in different positions in the various columns and then tested for crushing strength; other tile were tested singly. From the results of these tests it was found that where the tile did not absorb more than 12% of their weight in moisture, with vertical webs spaced not more than 4 in. apart, center to center, and with web thickness at least 20% of height and blocks placed so that the vertical webs occurred directly over each other, no single tile or column failed under a less load than 3465 lb. per sq.in. of vertical web section.

Under the authority vested in the Inspector of Buildings by the Cleveland Building Code, the writer ordered a fire test to be made to determine if hollow tile, erected as a wall supporting a heavy uniformly distributed load, would satisfactorily stand the fire test prescribed by the Ordinance. A testing inclosure was built with 12-in. walls having outside dimensions of 9 ft. 6 in. by 10 ft. 3 in. by 8 ft. 9 in. high, with a 3-in. coping of concrete on top. The entire top of the walls was loaded with an evenly distributed load of about 4066 lb. per sq.ft.

The internal temperature developed was over 2000° F. at the upper pyrometer and 1600° F. at the lower; the outside

*Building Inspector, City of Cleveland, Ohio.

wall surface remained cool throughout the entire test and showed no warping, settlement, or cracking of any kind. After the water had been turned on and the fire quenched, it was found that the inside plaster had been burned off but the inside face of the hollow tile was true and no apparent damage evident. Later, the rear wall was further loaded to an evenly distributed load of 9487 lb. per sq.ft., without showing evidence of crushing, cracking or disintegration of any sort.

After thus determining the properties of hollow tile from tests, the next step taken by the Department was the framing of a suitable specification regulating the safe use of these tile for load-bearing walls and the revision of the building code relative to the subject.

It is evident to the writer that hollow tile can be safely used in the construction of load-bearing walls, *only* when proper specifications are followed. The specifications must treat them from the standpoint of their supporting webs and not as solid units. The tile must be hard burned. Vertical webs must be spaced not too far apart, and their thickness must be proportioned to their height. All vertical webs must stand in vertical alignment with vertical webs in adjacent tile below and there must be mortar between tiles under the vertical webs. The following specifications cover these points, amply safeguard the use of hollow tile for load-bearing wall construction and at the same time are readily complied with by builders and tile manufacturers:

The limiting of the width of beds that the tile are susceptible of is a most important feature. The mason cannot be relied upon to bed properly and thoroughly a large unit with a broad bed. The mortar is likely to be omitted from a portion of the bed and vertical webs be left without a supporting mortar bed. By limiting the width of the bed that the tile is susceptible of, to 4½ in. (width of common brick), a good bedding will be as certain as in common brickwork.

The accompanying cuts illustrate two forms of tile that are used in this market and which comply with the specifications herein proposed.

From the results of the experimenting the Department have done and the consideration given the subject, the writer recommends the following as the essential points to be covered, by building-law restrictions, in permitting the use of hollow clay tile for the construction of load-bearing walls:

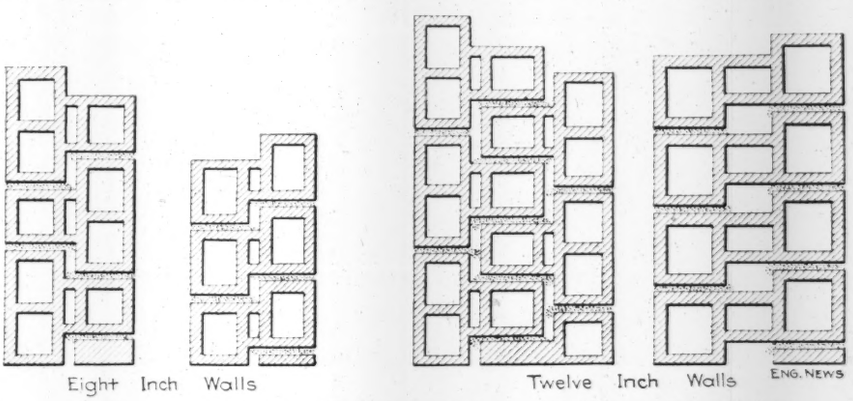
Tentative Specification for Hollow Clay Tile

(1) Quality of tile: Tile to be made of shale or fireclay or any clay that will burn to a good dense body without undue warping or checking and must be burned to such a degree of hardness that they will not absorb more than 12% of their weight in moisture.

(2) Webs: Vertical webs should be spaced not more than 4 in. apart, c. to c., and should have a thickness of at least 20% of their height.

(3) Bedding: To secure thorough bedding, tile should be so constructed as to preclude mortar beds of more than 4½ in. (same as brick work) in width, and should be laid with broken joints and be thoroughly bedded and bonded.

(4) Quality: Tile should be true and free from injurious checks and cracks.



Forms of Clay Tile Which Comply with Building Regulations

(5) Position in Wall: Tile should be so laid in walls that all vertical webs are in vertical alignment with vertical webs of the adjacent tiles below.

(6) Loads: Hollow-tile walls should be loaded with not more than 200 lb. per sq.in. of vertical web section.

(7) Thickness of Walls: Permissible thickness of walls same as for common brick.

(8) Joist Bearing: Where joists or beams are seated in walls, they should have a bearing extending over at least two of the vertical webs.

It will be noticed that the above specifications only contemplate the use of hollow tile when laid with their voids horizontal. This has been done advisedly. The vertical type has been avoided not only from the standpoint of insufficient bedding and bonding, but also from economical considerations. In the first place, the end of a tile web is too narrow (¼ or ¾ in.) for the mason to apply a mortar bed in a practicable way and in the second place heat nonconductivity is defeated in walls where the voids of the tiles are vertical. In order to secure nonconductivity, the tiles must be set in the wall with their voids horizontal. If the voids are vertical, opportunity is given for up and down circulation of air within the wall with the following result:

In summer the sun heats the exterior face of the wall. This heats the air in adjacent voids within the tile. The voids being vertical this heated air rises to the top of the wall. While the heated air is rising, the cooler air within the vertical voids adjacent to the interior face of the wall is falling, and, since it is impracticable to prevent communication between the exterior and interior vertical voids, circulation within the wall takes place, the air going up one side and down the other, transferring the heat from one face of the wall to the other. In winter the same operation takes place except the air currents take the opposite direction, and nonconductivity is not secured.

If, on the other hand, the tile are laid with voids horizontal, circulation within the walls is prevented; the air is confined and a nonconductive wall is secured.

It will also be noticed that, although no single tile or column failed under a less load than 3465 lb. per sq.in. of vertical web section, the above specifications limits the permissible load to 200 lb. per sq.in. of web section (a safety factor of about 17). This 200-lb. load when applied to tile as ordinarily made for load-bearing walls permits their being loaded over 5 tons per sq.ft. of wall area.

There is a marked difference between the clay body of the webs of hollow tile and that of common brick. This results from the different process by which each is manufactured, tile by the "stiff clay," and common brick by the "soft clay" process. A given weight of clay made into properly constructed hollow tile builds as much wall, of equal strength and far less conductivity than double that amount of clay made into common brick by the "soft clay" process, by which they are made.

The more the writer has studied the subject of building with hollow tile instead of common brick or wood, the more he has felt that it is a subject well worthy of careful investigation by engineers and architects, and that cities should avail themselves of the use of this valuable form of construction, by adopting specifications that properly prescribe its use. Cleveland architects as well as those in some other localities are recognizing that they can build tile residences, many of them stuccoed on their exterior, practically as cheap as frame and that are enduring and fireproof.

The suggestions embodied in the above refer particularly to tile laid with voids horizontally.

If it is desirable to use tile laid with voids vertically, a specification regulating this type of construction should be adopted in addition to the above specifications.

The Opportunities for the Engineer in Public Service

I believe that a crisis confronts us. The American people are determined upon a readjustment of the relations between the public and the utility corporations, whether you like it or not; and there is grave danger lest this readjustment (which is necessary) be harmful because ill advised.

It seems to me hardly possible to deny that such determination exists; that it constitutes our leading political issue. I remember talking a few years ago with a great "captain of industry" who scouted such an idea; he said that the agitation for "progressive" policies was a mere passing fad, and soon the American people would jostle down to their usual state of sobriety. I remember also that he was distinctly opposed to Mr. Taft's candidacy because Mr. Taft was "too progressive;" yet yesterday, when President Taft was enjoying the hospitality of Los Angeles and Pasadena, representatives of his party in thirty different states gathered in Chicago to endorse a presidential candidate in comparison with whom Mr. Taft has always been the most extreme of conservatives. The leading cause of the intense political agitation the country through is this determination of the people to secure a readjustment between the public and the utility corporations. It is this that has given rise to the adoption of the initiative, the referendum and the recall in California. Now, while I have no fear of the proper use of these tremendous implements that we have recently taken into our hands, I am afraid of a reckless abuse of them; and it seems to me that the engineer is to-day the only qualified mediator between the people and the public utilities.

In order that engineers may render the immense public service which the times demand, it is not sufficient that they possess merely professional competence. Such competence may fairly be assumed. But in addition to this, the crisis requires that an engineer shall be a man of affairs; versed in business usages to the extent of being an efficiency engineer; but versed also in economics and the history of American political reform. The helpful engineer must be nothing less than a publicist. It is a pity that our word "politics" has fallen into such sad repute. In its origin it is a word of dignity, denoting labor for the common welfare, the common weal; that is to say, the commonwealth. An engineer must not only know his own profession, but he must know politics; be in touch with the spirit of the times and able to assist in a proper direction of political reform.

Beyond that and above all that he must, in order to do his great work, be, to an extent required of no other profession to-day, a man of known unimpeachable integrity. When you come to the very crux of the matter, the real obstacle in the pathway of your helpfulness to the public is the stumbling block of doubt, or lack of confidence on the part of the people, in your incorruptibility. I do not question that the character of the average engineer is far above that of the average man in the street; my point is that you must have an extraordinary hold upon the people in order to win their confidence at this crisis, so that they will give entirely into your hands the solution of obscure and complex problems with which you alone are competent adequately to deal.

When the American people attain to complete confidence in the unimpeachable integrity of the engineering profession, their Yankee common sense will lead them to turn over into your hands, as a commission, the complicated questions involved in the readjustment upon which they are determined; and then this readjustment can be wisely accomplished, with the avoidance of that havoc which comes from ignorant bungling with a delicate mechanism. I repeat the thesis with which I began, that upon you rests the responsibility, and with you lies the capacity of rendering the largest public service possible for any class of American citizens at this time.

Speaking as one interested in the progress of education, it seems to me that there is no more important duty for an educator than to assist in the training of such engineers as these I have attempted to describe. Indeed, the more I think upon the subject of engineering education, the more strongly do I come to believe that the modern engineering college is in process of evolution into the typical twentieth century school for all sorts and conditions of men.

I believe that as the engineer stands to-day as potentially the type of the most useful American citizen, so the engineering schools are developing into a true pattern for the school of to-morrow, whose chief mission must be a high citizenship trained in the higher efficiency.

GEO. A. DAMON—For the last three years I have been connected more or less with this movement for public control of public utilities. For two years in New York I was associated with the consulting engineers for the Public Service Commission of the First District. For eight months I was in Pittsburgh studying the transportation problems there for the city administration, and since January, I have been here connected almost constantly with the question of the control of public utilities.

I am often asked, "Where is this movement going to end?" My opinion is that first it is to be public control; then it is to be public partnership, and then finally it is to be public ownership, but not necessarily public operation. Let me give you some of the reasons for this belief.

Public control, of which we know all too little at the present time, and which is not exercised at all in a scientific manner, especially in this state, as yet, must to my mind rest upon the following fundamental requirements.

First: That it should secure *adequate service.* Now note, I do not put the regulation of rates first. To the popular mind public control means the regulation of rates, and the regulation of rates downward. I believe in the regulation of rates and I believe in the regulation of rates downward. It is the natural tendency and we should work for it. It is the thing the engineers of this country are going to bring about, but it is not the first essential; it is the very last one.

The second fundamental is to *protect the actual investment.* There has been a great deal of money invested in these public utilities. There has been a great deal of time and energy put in them; we cannot confiscate that investment,—that time, ability and energy; it must be rewarded and it must be rewarded at a rate somewhat larger than simply interest rates. To determine the amount of the investment involves all of the problems of appraisal and valuation, and of depreciation, and the question of what a fair return is upon an actual investment. These are all technical problems.

The third essential is to provide *some definite form of renewal fund.* If our service is to be adequate, if our investment is to be protected, we must have some automatic system for keeping the plant up to date and up to its highest efficiency, so we must study the question of depreciation and the requirements of the renewal fund.

The fourth fundamental is that of *betterments and extensions.* Some people seem to have the idea that a public utility becomes finished; that after a certain investment is made, that is all there is to it. Even the bonding people begin to retire their bonds after a certain amount of development. But from my study of the transportation systems of the entire country, I found this to be true; that in general the earnings increase as the square of the population. That means that when the population doubles, the "riding habit" also doubles, and if the income per capita doubles and the population doubles, the total gross income increases by four times. Thus every dollar of increased annual earnings in transportation means a demand for about four dollars additional investment. We cannot

*Extracts from addresses by James A. B. Scherer, President, Throop Polytechnic Institute, Pasadena, Calif., and Geo. A. Damon, Dean of the Institute, before the Los Angeles Branch of the American Institute of Electrical Engineers.

get this supply of capital at reasonable rates unless the present investment is protected.

The next fundamental I shall touch upon is very seldom spoken of,—and that is the requirement *to amortize part of the investment.* We recognize in making appraisals that there is something more than the physical value or the cost to produce the plant; we recognize what we are pleased to term development expenses,—some people call them "intangible values." They consist, for instance, of the discounts on the securities, of the profits of promotion; of the cost of consolidation,—because it costs money to get together the several systems that go to make a complete public utility. They include, perhaps, a few engineering mistakes in the past that are almost unavoidable in the developing of the property, and a number of superseded investments that do not show upon the surface.

All of these development expenses may amount to all the way from 20 to 50% of the cost of reproducing the plant new, but because they are "intangible" and because you cannot see them, it would be better if the capital represented by these development expenses were wiped out. So I maintain that out of the first real earnings of the plant, money should be taken to retire the investment in those development, intangible values, and there should be a fund created for that purpose. This is a point that is very often overlooked.

The next essential is *to eliminate competition.* We at one time thought the proper method of regulating public utilities was by means of competition, and if we had a telephone company that was not giving us good service we gave a franchise to another telephone company and sought to regulate the service and rates in that way; or in the case of a lighting company that did not reduce its rates, we gave another franchise to a hostile system. Well, what was the result? We at once had a duplicate investment; two dollars doing what only one dollar should; a duplicate management and comparative inefficiency all the way down the line. The competition certainly reduced the rates temporarily, but neither company could give thoroughly adequate service.

Public utility service as a rule is a natural monopoly; it should be encouraged as a monopoly, but as a regulated monopoly and as a protected monopoly. But if we encourage this monopoly how are we going to most effectively control it? Make the rates high enough or refuse to reduce them until such time that the income will take care of these fundanental essentials; until we have a depreciation fund to take care of our renewals; until we can be sure that we can take care of our maintenance and operating expenses; until we can pay a proper return on the investment; until we have money in the surplus fund to amortize some of the capital, and then let us retire some of it.

There should be a surplus fund created with every public utility, but that surplus fund should not belong to the company. To my mind there is where scientific regulation can do its best work. Let the control of this fund be put in the hands of a technical commission which understands the business, and what will be the result? If it wishes to renew some of the property or replace some inefficient part with something that is more efficient so as to cut down the cost of operation, this fund will be sufficient for that purpose. If it wishes to extend the system into parts of the city where, for a time, there will be a non-paying load, that fund is available for that purpose. If it wishes to amortize some of the capital so that fixed charges will be reduced, part of the fund can be used in that way. A surplus fund of this kind would give a stability to the whole enterprise.

Finally, when the fund gets sufficient to do all these things, then is the time to reduce the rates, and the reduction of the rates will naturally follow, because both the fixed charges and operating expenses have been lowered. While the whole program tends towards the reduction of the rates, it does not put the reduction of rates as the first essential.

If the surplus fund of the public utility corporations is thus controlled and at the same time the investment is made stable by insuring a return on the actual value of the property, then by this very arrangement the public enters into a partnership with the utility company.

This is not an idle theory, for it has been worked out in actual practice. We have practically this same arrangement in the Chicago traction situation. In working out the transportation problem there, a contract ordinance was entered into between all of the railway companies and the city, in which the railway companies are practically operated as a protected monopoly. The companies are allowed 5% return on their actual investment and the surplus fund is then divided; 55 per cent. to the city and 45 per cent. to the company. The company is required by ordinance to maintain its property and have a sufficient renewal fund. In making the arrangement the intangible values were given a certain value, and incidentally a great many of them were amortized at that time.

To-day the city of Chicago and the railway companies are in partnership, and the city of Chicago is accumulating a fund which is available to either build subways, to extend the service into non-paying districts, to reduce the fares or to buy out the company. So public partnership may actually end in public ownership.

To my mind, if this evolution does end in public ownership of these utilities, there will be the danger of inefficient operation. I see only one way of overcoming it, and that is, after we get public ownership, to eliminate public operation and turn over the operation of these utilities to strictly *operating companies* organized without any need of raising capital, or of financing, or of getting franchises, or of going into politics. I have talked this suggestion over with some of the most prominent operating men in this country and I think I can see the day when there may be such operating companies, composed of an efficient and dependable organization working on a bonus basis.

Last week the State of California voted to extend the duties of its State Railroad Commission so that it would have the powers of regulation over all of the public utilities in this state. The Railway Commission of Wisconsin has similar powers and its work commands the highest respect. Why? The Wisconsin Commission turned over its technical problems to an engineering organization which is controlled by the professors of the State University. From the first it built up a fabric of decisions based upon the reports of its engineers.

"Hillside Houses for Working Men" is the subject of a brief report of the committee on housing of the Pittsburg Civic Commission, published in the November "Civic Bulletin" of the commission named. The report states that two notable features of Pittsburg are the lack of small sanitary and attractive houses located near the working places of the citizens, and the barren unused hillsides of the city. It remarks that "the typical Pittsburg hillside is about 50% grade." The question arises, "Can the Pittsburg hills be utilized for small homes?" After two years' study a plan for such utilization of the hillside has been evolved. It is proposed to build streets with 6 to 8% grades along the sides of the selected hill which would be no greater than the grades of many streets in built-up portions of the city. These streets would virtually form a series of terraces up the hillside, spaced 32 ft. apart for single houses, and 92 ft. apart for blocks of four houses. Where the streets are 32 ft. apart the houses would be built in rows and each house would have an entrance on each of the streets on which it faces. Such houses would be 14x32 ft. in plan; every room in them would open directly on unobstructed air space and the walls of each house would be 30 ft. from any opposite wall. On the streets 92 ft. apart the houses would be built in blocks of eight, four in a row, back to back, but with spaces 26 ft. wide between each block of eight houses, extending in terraces from street to street. Steps would run from street to street through these terraces. Like the houses on the streets 32 ft. apart, those on the streets 92 ft. apart would be but one room deep, with every room opening on an air space. The houses on each type of street would contain a kitchen, a living room, two bed rooms, a bath and laundry.

Automatic Water Supply Booster

By C. A. Tupper*

For the water supply of Gerresheim, Dusseldorf, an auxiliary pumping station was provided as this suburb was above the city high-service reservoir. Motor-driven pumps supply the local mains through storage tanks where the pressure is held by compressed air. Drop in pressure, due to use of the supply, automatically starts the pumps.

*Consulting Engineer, 389 Thirty-first Ave., Milwaukee, Wis.

The writer, while on a visit to Düsseldorf, Germany, had an opportunity of inspecting what proved to be a very interesting auxiliary, or "booster," plant extending the water supply of that city to the suburb of Gerresheim. In 1909, when this community of about 15,000 people was incorporated into the municipality of Düsseldorf, the necessity for a better water supply became imperative. How to cope with the situation was a serious problem. Mere extension of the municipal mains would be of no avail, for Gerresheim is situated on high ground, considerably above the level of the Düsseldorf high-service reservoir. Nor did the city authorities feel warranted in going to the expense of providing a new and independent water system for this suburb. Hence, they resorted to the installation of a plant operating on what is called the "Delphin" system.

The arrangement consists essentially of (1) three centrifugal pumps with 8-in. suction and discharge pipes, driven through flexible couplings by three-phase alternating-current motors, and (2) suitable storage tanks, pressure regulators and automatic-control apparatus. The aggregate capacity is 44,000 to 55,000 gal. per hr., the operation being as follows:

FIG. 1. THE GERRESHEIM AUXILIARY PUMPING STATION, DUSSELDORF, GERMANY

The water, taken from a lower level at the end of the Düsseldorf system, is raised by the pumps and forced into closed steel pressure tanks or reservoirs, (See Figs. 2 and 3) supplying the distribution mains. Before these tanks were put in service initially, their service valves were closed and they were allowed to fill half way with water. Then the valves were closed and air was supplied from a small motor-driven compressor until the gages registered a pressure corresponding to that required for the mains, the equivalent of 100 ft. head. The service valves were opened and the pumps and compressor allowed to operate until the system gained its equilibrium. This procedure is, of course, repeated for each tank, whenever it is emptied for cleaning, etc. But the operation of the system as a whole has been automatic since it was first started.

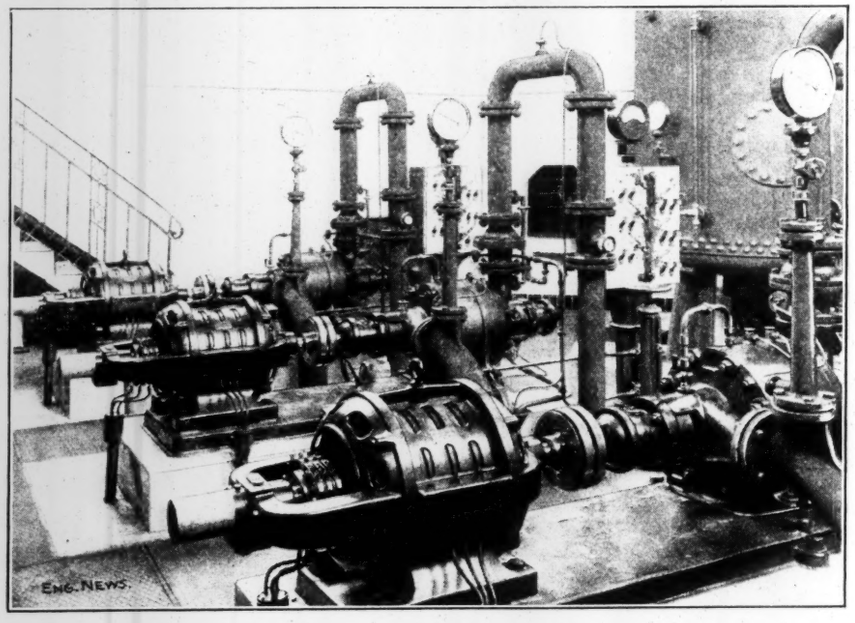


FIG. 2. BOOSTER SETS IN THE GERRESHEIM AUXILIARY STATION

The equipment of each tank includes a pressure gage, water-level gage and an automatic switching device operated by pressure changes. It will be plain that, as water is drawn off through the distributing mains, it will be renewed from the tanks under the action of the compressed air, and the pressure in the tanks will drop off. When it falls below a predetermined limit, which in this case is about 37 lb. per sq.in., a piston-actuated switch, closes the circuit of the first motor, starting the pump coupled to it. This unit continues to work until the water consumption diminishes or becomes greater than the quantity being supplied. In the first case, the circuit is opened when the former pressure is restored and the pump is stopped. In the second case, the pressure drops further and the second unit is cut in, and, if necessary, also the third. All pumps then operate until diminishing demand renders the service of one superfluous, when the pressure rises and the third is cut out. Immediately the consumption falls below the capacities of the first and second pumps, these in turn cease to operate. As a rule, the plant remains inactive after midnight and consumes very little power during the quieter hours of the day. Small quantities of water can be drawn off without calling the pumps into play, the difference in the pressure and reserve of water in the tanks sufficing; this condition could be extended, if desirable, by means of more or larger tanks.

Relatively even wear of the pumping units is secured by changing the switch connections, at intervals, to start one and then another first.

If fire breaks out, suddenly requiring large volumes of water, all of the pumps

are brought into action automatically and worked to their capacity as long as needed. Thus far, in Gerresheim, they have proved equal to every necessity.

Should one of the pumps break down or be purposely cut out while in service, for any reason, the next unit will automatically come into operation. Consequently, the continuous working of the plant is well safeguarded, except in the case of a failure of the electricity supply.

The present equipment in Gerresheim will be ample until after the population has risen to 25,000, allowing for corresponding extension of the mains; when the time comes for increased capacity, this can be very easily secured by the

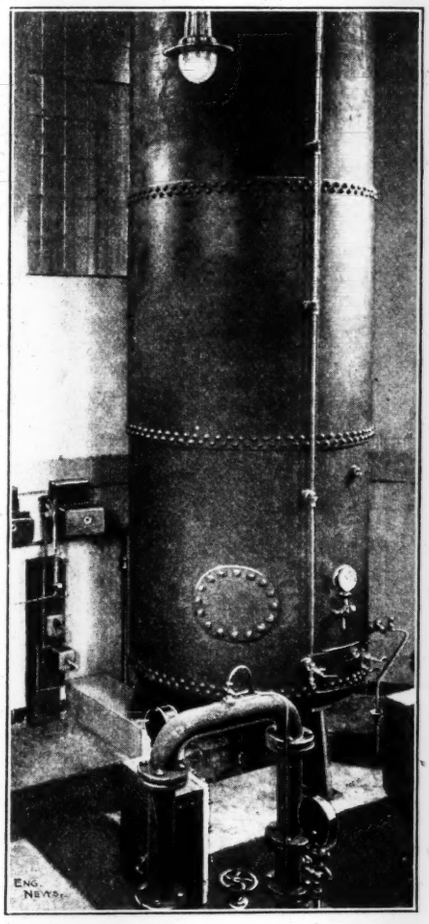


FIG. 3. STORAGE TANKS, GERRESHEIM BOOSTER STATION

installation of additional units. The erection of another tank, to later serve in connection with the next pumping unit, would probably suffice for a while.

The system has also been applied abroad to water-works supplying mains in which one pressure is not sufficient for all parts of the district served. Under such circumstances the plant supplies a zone of higher pressure taking water directly from the mains or through an auxiliary reservoir and automatically developing the increased pressure required.

In a like manner, the system described is being adapted in Germany and elsewhere to the needs of cities where the distribution mains have become greatly extended as compared with the provision originally made for growth. The elevated reservoir no longer suffices and the distributing mains are too small for the increased pressure required to force water to the outlying districts. It is then found advantageous and, in fact, may be imperative in holding fire insurance, to install the auxiliary booster plant.

The installation of motor-driven pumps of all classes has been greatly facilitated in Europe, of late years, by the constant extension of electric generating and transmission systems. These latter, as a result of the development of water powers and the use of lignite or other cheap fuel in steam plants, have been extended in a network through agricultural sections and districts devoted to small manufacturing. For the communities contained in these stretches of country, electric pumping units afford water service at low cost. The necessity for an elevated reservoir or tower has, however, been an obstacle in many cases and the expense of attendance is also a factor to be considered; hence the Delphin system, which does away with the tower and requires only occasional oversight, presents peculiar advantages for this character of service.

The cost of a system for a place of 25,000 inhabitants, is about $16,300 including the station building, which at Düsseldorf is a small brick and stone structure.

The Gerresheim plant was built late in 1909 by the firm Heinrich Scheven of Düsseldorf and it has been in continuous operation since the beginning of 1910. Electric current is taken from the Düsseldorf municipal station and the plant is under the direction of the city gas, water and electricity board.

A Reinforced-Concrete Chimney for Exhaust Gases from Gas Engines

In the Dec. 22, 1911, issue of London *Engineering* there appears an article by Oscar Faber describing a reinforced-concrete chimney which he has recently built in London, Eng., to carry the exhaust gases from internal-combustion engines to such a height from the ground that they cannot constitute a nuisance to the surrounding neighborhood. The stack is erected to replace four steel pipes having a total height of 85 ft. from the ground, which were found to be insufficient to effect the above-mentioned purpose, much less to carry the gases from several new units which the company proposed to install. The shaft is 144 ft. 9 in. in height, measuring from the top of the foundations, which coincide with the basement-floor level, and is cylindrical in shape, with an inside diameter of 2 ft. 6 in. In considering the design of the chimney the engineer at first thought that it should be built of brick, but according to the building regulations of the city of London a brick chimney of this height would need to be 12 ft. in outside diameter and 9 ft. in inside diameter at the bottom, and 4 ft. in outside diameter and 3 ft. in inside diameter at the top. Such a chimney was considerably greater than could be erected at the site, owing to the scarcity of ground room. The alternatives were, therefore, reduced to a self-supporting chimney of steel or of reinforced concrete. The first of these could not be passed as a permanent structure by the city authorities, owing to the corrosion of the steel work, so only a reinforced-concrete chimney could meet the requirements.

The chimney has an outside diameter of 5 ft. for its whole height of 144 ft. 9 in. It rests on a solid concrete block about 15 ft. cube and extends with an annular section 5 ft. outside diameter and 2 ft. 6 in. inside diameter, for a height of 64 ft. above the top of the foundation, at which point the flues carrying the gases enter. Above the entrance of the flues the section is 5 ft. in diameter with 6-in. concrete walls and an interior lining of firebrick 5 in. thick, with an intervening 4-in. space so as to give an interior diameter of 2 ft. 6 in. The firebrick lining consists of special firebrick made with a raised rim 2x¾ in. fitting into a corresponding recess in the next course. To insure the lining remaining concentric with the outer shell, special brick with side projections were used at intervals 10 ft. apart. About ⅜ in. clearance is left between these projections and the outer shell to allow for expansion.

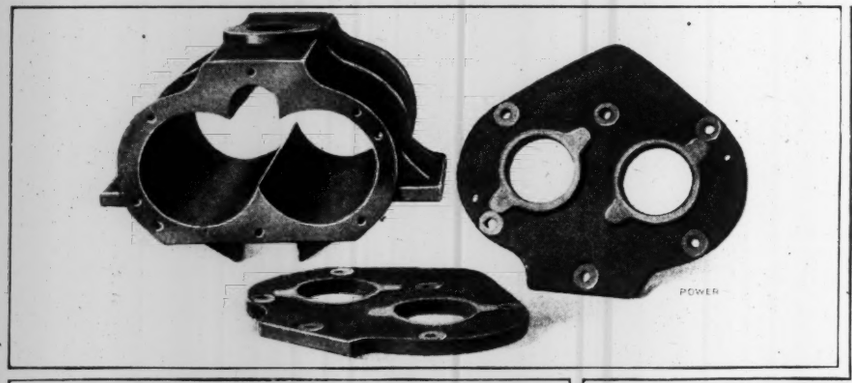
The author states that some theoretical calculations of temperature stresses led him to a system of construction in which wooden rings are embedded at intervals on the inside face of the concrete shell, which practically reduces to zero the stresses due to expansion. The reinforcement of the concrete shell consists of vertical bars distributed around the outer circumference of the shell and bound together at frequent intervals by circumferential iron bands.

Four lightning conductors were screwed on the tops of four longitudinal reinforcing bars, thus saving the copper strips down the length of the chimney. Electrical connection was made between the lower ends of the bars and the earth and a test of the resistance between the spikes of the conductor and the earth showed that the connections were all that they should be. According to the author, this is of special interest, as no special precautions were taken to insure good contact where the longitudinal bars lapped with those of the higher tier.

A Rotary Engine with Herringbone-Gear Rotors

Some time ago three different rotary engines were described in these columns which had given, it was claimed, economies ranging from about 31 to 45 lb. of steam per horsepower-hour. Another and distinctly different engine invented by John H. Van Deventer, Superintendent of the Buffalo Forge Co., Buffalo, N. Y., has recently entered the field with corresponding claims of economy and with a considerable apparent advantage in simplicity of construction.

This engine consists simply of two herringbone gear wheels meshing together and revolving in a close-fitting casing.



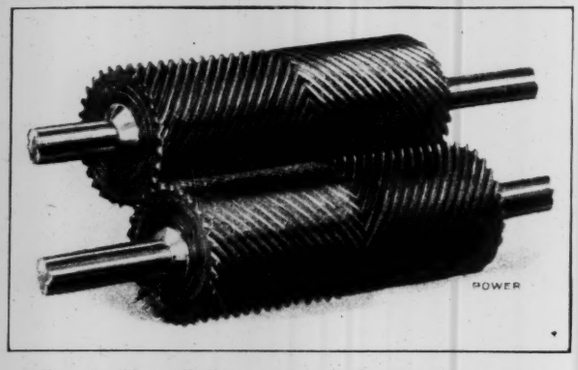


FIG. 1. "SPIRO" ENGINE WITH ROTORS REMOVED FROM CASING

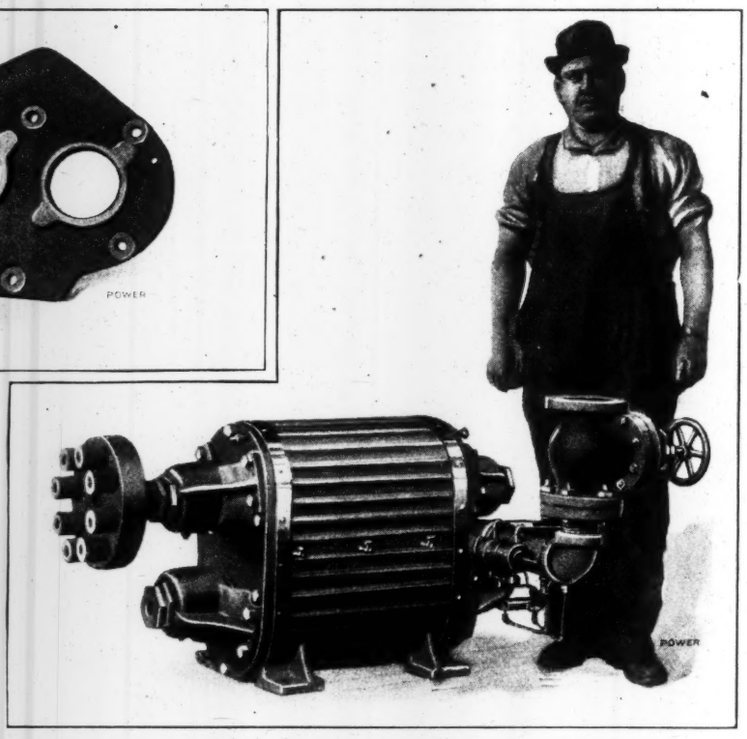


FIG. 2. A 186-HP. UNIT WHICH HAS BEEN IN USE THREE YEARS

A pair of the gears, or rotors, and their casing is shown in Fig. 1. It is notable that the herringbone rotors are much longer axially in proportion to their diameter than ordinary herringbone gears for power transmission would be.

Steam is admitted at mid-length of the rotors, at the point where the teeth of opposite spirals meet. Thus the steam occupies the space between two adjacent teeth, and this space is closed at the tooth points by the closely fitting casing. As the rotor turns, the tooth-space occupied by the steam increases in length and the steam expands. Finally the steam escapes when the outer ends of the teeth pass the line of contact of the two rotors. The increase in length of the tooth-space from the time when steam is first admitted until the exhaust occurs is shown by the diagram, Fig. 3.

The inlet-port openings, as indicated in the diagrammatic sectional view, are situated one on each side of the central rib, shown inside the casing at the bottom in Fig. 1, which divides the casing into two partly closed cylinders. The ends of these cylinders are covered by the heads which are shown removed in Fig. 1, but no effort is made to have a steam-tight contact between the heads and the ends of the rotors. In fact, space is left between the rotor end and cylinder head for the passage of the exhaust steam. The steam passes from these end spaces to the exhaust port shown at the top of the casing in Fig. 1, which communicates with the exhaust pipe.

The rotors are mounted on shafts turning in long bearings which are either attached directly to the cylinder heads or bolted to the base casting. On small units, ball bearings are used, while the larger sizes have bearings so designed that each bearing acts as an individual oil pump to circulate oil between the shaft and bushing with a positive pressure.

This engine, under the trade name of the "Spiro turbine," is now being made in sizes up to 60 hp. The 186-hp. unit shown in Fig. 2 has been in use for three years by the Buffalo Forge Co., driving fans, gas scrubbers and other apparatus requiring a running test. It has never been taken apart, nor needed a single adjustment in that time. The following results of noncondensing tests with units developing 25 and 150 hp., are given out by the makers:

	Test 1	Test 2
Boiler pressure, by gage, lb.	120	130
Initial pressure, by gage, lb.	101.5	115
Horsepower	25.3	151
Speed, r.p.m.	2450	2710
Water per b. hp.-hr., lb.	53.2	31.8

ANALYSIS OF STEAM ACTION—In tracing the analogy between this so-called "Spiro turbine" and the reciprocating engine, the tooth-space to which steam is admitted takes the place of the cylinder, the tooth ahead becomes the piston and the abutment against which the steam pressure reacts is formed by the tooth of the other rotor, which closes the end of the tooth-space at the line of rotor contact.

In Fig. 3, the tooth-space marked *A* is about in the position where steam is first admitted. A glance at the diagram shows how this space increases in length until the position *B* is reached (after about half a revolution of the rotor). When the end of the tooth-space is no longer closed the exhaust occurs.

The time of cutoff depends on the axial length of the inlet port. The intersections of each tooth-space with the line of rotor contact move from the midlength of the rotors toward the ends, when the engine is running; and as each tooth-space passes in this way beyond the end of the port its steam supply is cut off by the tooth behind. In the units already built, the number of expansions; that is, the ratio of the tooth-space length at cutoff to the total length at beginning of exhaust, has been made from 3½ to 6.

A cutoff governor, which operates by varying the length of inlet port, has been designed. A throttling governor could be equally well applied.

The power in foot-pounds which should be developed by each tooth-space is found by multiplying together the mean effective steam pressure, length of tooth, right sectional area of tooth-space and revolutions per minute. In other words, we have for the horsepower the familiar formula

$$Hp. = \frac{PLAN}{33{,}000}$$

the only change being that L is now the length of tooth-space instead of length of stroke. To get the total combined horsepower of both rotors, we must multiply by twice the number of teeth on each one.

A rough computation in this way of the horsepower of a unit with rotors 3 in. in diameter by 7 in. long with 20 teeth, an initial steam pressure of 100 lb. and 2000 r.p.m., gives about 3 or 4 hp. This corresponds fairly well with the rating given by the makers, the Buffalo Forge Co., of Buffalo, N. Y. The engine rated at 1 to 3 hp. has a length of casing of 8¾ in., and the width is 8¼ in. The total length over bearings is 16¾ in., and the weight is 100 lb.

The great problem of steam leakage in rotary engines is simplified in this design by the fact that the exhaust steam escapes at the ends of the rotors. No packing, therefore, is needed there. The rotors and casing can be made with a very slight clearance, a few thousandths of an inch perhaps, between them. Moreover, the pressure difference between adjacent tooth-spaces is small and this tends to minimize the leakage over the tooth points.

The greatest loss of steam by leakage, then, will be mostly at the line of contact of the pitch cylinders of the two rotors, where the teeth are in mesh. Here we have pressures in the several tooth spaces ranging from the initial to the exhaust pressure, on the inlet side; and the exhaust pressure all the way across on the other. There must be some clearance between the teeth, at least at the points, and it appears that some leakage must occur. The leakage here may be reduced, however, owing to the high speed of the meshing teeth in a direction opposite to that of the leaking steam, below what would otherwise be expected. From the economic results claimed, it appears that the leakage is not great enough to seriously affect the engine's performance.

The only point of wear, beside the bearings of the rotor shafts, is at the contact of the teeth. As already noted the rotors are much longer axially than power-transmission gears would be, and the larger number of teeth in contact reduces the tooth pressure. The tooth pressure in the engines as built, we are informed, is only about 5 lb. per sq.in., making the wear very slight.

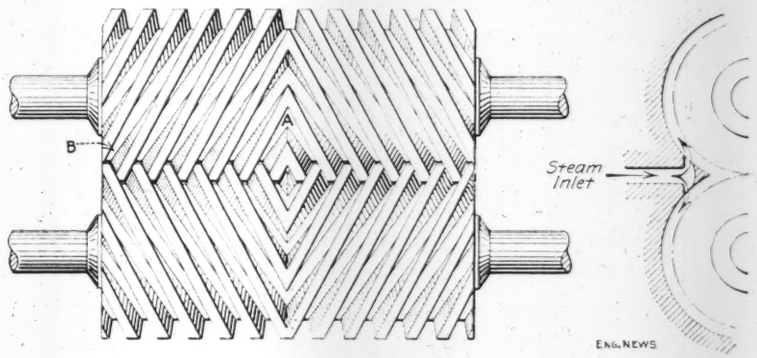


FIG. 3. DIAGRAMMATIC SKETCH TO SHOW STEAM ACTION

Three Essentials in Town Planning*

Sir W. H. Lever, M.P., speaking at a conference at Manchester on the powers and duties of local authorities under the British Housing and Town Planning Act, 1909, made some interesting remarks on practical methods.

The three essentials to success in town planning were the public well-being, economy, and beauty. Without them it was a failure.

It was undeniable that the death-rate in towns was invariably in proportion to the number of the inhabitants on a given area—highest where there were fifty or sixty houses to the acre, and lowest where there were only five to ten. In the United Kingdom there were two hundred thousand unnecessary deaths through overcrowding alone—more than eight times the number who lost their lives in the South African war.

In sickness the average working man was losing five weeks out of every twelve, and it was easy to imagine the awful drain there was in doctors' bills, loss of wages, and food for the family, and the consequent deterioration. Then there was the great drain in the mortality of infants at a time when the struggle between nations was not going to be decided by Dreadnoughts or naval or military officers, but in the cradle.

If a proper town planning scheme had been in operation in the large towns and cities there would have been no necessity for the great and expensive widening schemes so frequently heard of today. Properly carried out town planning could not only be made inexpensive, but would actually in future leave a town low-rated.

People in business tried to avoid towns with high rates, especially if they intended going into building operations or opening out new industries. Perhaps the most economical way of carrying the scheme out would be to acquire the fringe of land surrounding the town, and to do this at such times as the land was placed in the market by a willing seller, not by compulsory powers. When compulsory powers were exercised one never knew what price might have to be paid.

In the past, in the laying out of our towns we had not done the blending together of city and park that we should have done.

Not much good would be done by going to the Continent to imitate what was done there. They must study their own country, and remember that it was the practical which was always ideal, though he did not say that the ideal was always practical. He did not believe at all in a waste of effort to produce effect. The effect would come naturally if the thing was done right, and they were doing right in limiting the number of houses to ten to twelve to the acre, in providing open spaces for children, and good wide roads with little islands for the safety of the people.

Two centuries ago England led the world in town planning. In the last century and a half they had become immersed in commerce without thought of the beautiful laying-out of their towns, and everything had gone wrong and astray. When the Housing and Town Planning Bill was being introduced into the House of Commons opponents said it was very good, but should have been passed fifty years ago; that the towns were built now, and that they had spent the money and done it badly, which was one of the strongest arguments in favor of the Bill.

The town planning scheme could be best carried out by the local governing body, for they would have their own staff of engineers *permanently attached to them*, who would understand the district better than any outsider, and they could be aided by both business and professional men among them or in their communities.

The first thing to consider was the occupation of the inhabitants. In a residential district the arrangement would have to be different from that in a busy industrial place. The plan should always be made to fit the district. It was not wise to make a plan first and then try to patch it on to the district. Levels and contours and the points of the compass should be taken.

*Condensed from The Surveying and Housing World (London, Dec. 30, 1911).

In the case of a manufacturing district the factories and workshops should be located on low-lying ground alongside railways, canals, or water highways at the east end of the town. The prevailing winds being from the west, the smoke would then be blown away from the town. The homes should be at the west end, and on as high ground as possible. In respect of regulations the fewer limitations the better. Nothing could produce greater prejudice against a town planning scheme than for people to think their liberty would be restricted if they entered into such an area.

Lewis Kingman

In the hospital of the National Railways of Mexico, in the city of Mexico, on Jan. 24, occurred the death, from pneumonia, of Lewis Kingman, another of our famous pioneer American railway builders, a contemporary and coworker with Howard Schuyler and Henry R. Holbrook, whose careers were briefly sketched in our issue of July 20, 1911. Although nearly 67 years old, Mr. Kingman died while still in active service as Office Engineer of the National Railways of Mexico.

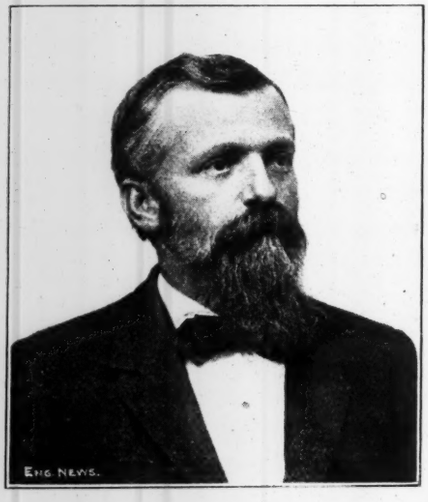
Again we feel the need of adequate biographical material to do justice to the lives of those men, who perhaps more than any others were the real builders of the West. The achievements of half a century of a life devoted to engineering during the era when the vast western empire has been created, cannot be adequately recorded in a few words in the columns of a periodical, but are written between the lines in every history of that great section of country, which owes much of its extraordinary development and prosperity to such achievements.

Lewis Kingman was born in Brockton, Mass., on Feb. 26, 1845. After graduating from Hunts' Academy in Brockton, he spent two years in the office of Shedd & Edson, Civil Engineers, of Boston, Mass., where many another notable engineer received his early training. Here he gained experience in city and suburban surveying and spent some time as a leveler on the Stoneham Branch of the Boston & Lowell R.R.

For the four years subsequent to 1864 he was engaged in engineering work in Wilkes-Barre, Penn., and in the Pennsylvania oil fields. But this was a period of rapid railway building on the great plains west of the Mississippi River, a field promising fortune and fame, as well as adventure, which attracted many young engineers of that day. In 1868 we find Mr. Kingman in St. Louis, Mo., where he entered the service of the Atlantic & Pacific R.R.

Three years of railway experience in Missouri as Division Engineer on location surveys was the beginning of a long and distinguished career in the field of railway construction. In 1871 and 1872 Mr. Kingman was engaged on location surveys in Colorado and New Mexico, and the following three years in public-land surveys in New Mexico. He then returned to railway work with the Atchison, Topeka & Santa Fé Ry., and in 1879 was transferred to the Atlantic & Pacific R.R., at that time a subsidiary company, as Locating Engineer under Henry R. Holbrook, its Chief Engineer. During this period he also served as Resident Engineer in charge of construction of the division between Winslow and the Colorado River in Arizona.

When Mr. Holbrook resigned as Chief Engineer to return to Mexico in 1882, Mr. Kingman succeeded to that office;



Lewis Kingman

but he also resigned within a year to follow his recent chief to Mexico, where he became Chief Engineer of the Mexican Central Ry., succeeding Howard Schuyler, who had been obliged to resign on account of ill health. Thus were the lives and fortunes of these pioneers interwoven, so, were it possible to combine in one volume their joint experiences, we should have not only biographies of great men and famous engineers, but a history of great engineering enterprises as well.

After completing his work in Mexico, which included the building of 452 miles of track, he returned to the Atchison, Topeka & Santa Fé Ry. as Assistant to Chief Engineer Robinson, and was in charge of construction in Kansas, the Indian Territory and Texas. Under his supervision there were built 508 miles of railway track in 1886 and 845 miles in 1887, certainly a record which few engineers have ever exceeded.

In April, 1889, he was appointed by the Mayor, City Engineer of Topeka, Kan., a position which he filled for six successive years, through administrations of three Mayors. In 1894 he returned to Mexico and within a few months again became Chief Engineer of the Mexican Central Ry. When this railway was merged with the National Railways of Mexico in 1909, he was made Assistant Chief Engineer and Office Engineer of the latter system; and he was at work in his office in Mexico City till within 24 hours of his death.

Mr. Kingman, from his long and varied career, leaves a wide circle of friends and acquaintances throughout the West. He was among the best known and best liked of the Americans resident in Mexico, where a good part of his life was spent. He had been a member of the American Society of Civil Engineers since 1885 and was a charter member of the American Railway Engineering and Maintenance of Way Association. He was also a member of the National Geographical Society, the American Academy of Political and Social Science, the Franklin Institute of Philadelphia, and a prominent member of the Masonic Fraternity.

He is survived by a widow and five children, who were in Topeka, Kan., at the time of his death.

Instruction in the Economical Use of natural gas is being given without charge by the gas inspector of Kansas City, Mo., by means of a demonstration apparatus provided for that purpose. The apparatus is located in the gas- and meter-tesing laboratory in the city hall. It consists of a regular gas meter with glass top and sides; two ordinary lights, one with and one without a mantel; a plate-burner stove upon which "can be placed a contrivance, forming a small furnace or heating stove, with a smoke pipe and gas damper in this pipe." By means of this apparatus would-be learners can see how gas may be consumed economically and also how it can be burned at a loss. The natural-gas supply of Kansas City comes from the Kansas and Oklahoma gas field and has recently been furnished through meters at 25c. per 1000 cu.ft. Since Nov. 19, 1911, the gas company has authority under its franchises to charge 27c. per 1000 cu.ft. The gas inspector states that in almost every instance of excessive gas bills they are caused by the improper use of gas. Robert W. Goodnow is city gas inspector. The information cited above, together with other information for natural-gas consumers, is given in a neat pamphlet published by Mr. Goodnow's department, with the indorsement of the mayor and of the Public Utilities Commission of Kansas City. The mayor states: "One of the most important results to be accomplished by municipal government is to secure through the people of the municipality the furnishing of the great municipal utilities at the lowest possible cost consistent with the highest grade of service." The commission has jurisdiction over all the gas, electric-light, street-car, telephone, telegraph and railroad companies doing business in Kansas City. The commission consists of a president, secretary, counsellor and two other members. Chester C. Smith is secretary.

Letters to the Editor

Protecting Dams Against Floating Bodies

Sir—I have just seen a set of instructions issued by the State Conservation Commission of New York for guidance in building dams. Reading this over for use in my future dam-building work, one passage did not appear clear to me. It provides for the construction of fenders on masonry dams with the object of protecting the dam against "ice and floating bodies." Such provision is unusual, but the way in which the construction is described is even more unusual. In fact, I consider it unintelligible. It reads as follows:

> The masonry must be built up in horizontal sections with center grooves in the top and sides for bonding, formed by embedding beveled timbers in the concrete. Concrete masonry shall have vertical cast-iron bars in the upstream face, placed at least 2 ft. apart and of sufficient length to protect the masonry against ice and floating bodies.

I would be greatly obliged to you for an explanation of this clause. As already remarked, I do not understand it.

O. B. CLEAR.

Yonkers, N. Y., Jan. 15, 1912.

Doing Things to Dams

Sir—Apropos of recent dam failures in Pennsylvania and Wisconsin, the following extract from an editorial in the Worcester (Mass) *Telegram* shows the layman's idea of what can be done to dams:

> Within 70 miles of Worcester is the southern border of a section of New Hampshire that is to be developed for all the hydro-electric power it can furnish. This project is capitalized by Vermont men, in Maine, at $15,000,000, for New Hampshire development to provide power for Massachusets. The plan is to develop the entire power of the section, to make 120,000 more horsepower available. It is to be done by modern methods of economizing the power of water as it falls down among the hills. Rapids in rivers are to be taken at their true worth. That is done by taking the water at the head of the rapids and coaxing it out to the top of a hill by means of pipes or aqueducts, where it will be allowed to fall in full volume directly on the wheels. And dams that are now in use are to be raised at the top to hold back more water. And other dams are to be lowered at the bottom, that the water may fall farther and make more power.

When these old dams are raised at their tops, and others lowered at their bottoms to take their humble part in turning the wheels of industry, engineers will not go to Panama sightseeing, but will go and stand in amazement to see the works of those "Vermont men capitalized in Maine to utilize New Hampshire water for the benefit of the people in Massachusetts."

WILSON T. HOWE.

Division of Port Works,
Manila, P. I., Dec. 4, 1911.

An Error in Proportioning Concrete

Sir—There is a common error made in the proportioning of concrete mixtures, to which attention should be called. It lies in considering the sum of the aggregate proportions to be the vital point of the mixture and in disregarding the respective proportions of fine and coarse aggregate. A case in point has recently come to the attention of the writer.

The specifications in this case called for a mixture of 1 part cement, 3 parts sand and 5 parts broken stone. The contractor furnished instead a natural mixture of sand and gravel, and after an examination of the material, the engineer-in-charge ordered the use of a mixture of 1 part cement and 5 parts of the natural sand and gravel, on the ground that "the interstices contained the other 3 parts sand" (?).

From experiment it has since been found that 1 cu.ft. of the natural mixture, measured in a box 1 ft. cubed, contained 0.45 sand and 0.75 cu.ft. gravel when the two materials were separated. It may thus be seen that to conform to the specifications, the contractor should have used $8 \div 1.2 = 6.66$ cu.ft. of the mixture to 1 cu.ft. of cement, with the following result:

$$\begin{array}{l} 6.66 \text{ cu.ft.} \times 0.45 = 3.0 \text{ cu.ft. sand} \\ 6.66 \text{ cu.ft.} \times 0.75 = 5.0 \text{ cu. ft. gravel} \\ \hline 8.0 \end{array}$$

Suppose, for example, that the mixture had contained 0.3 cu.ft. sand and 0.9 cu.ft. gravel to each cubic foot, then

$$\begin{array}{l} 6.66 \times 0.30 = 2 \text{ cu.ft. sand} \\ 6.66 \times 0.90 = 6 \text{ cu.ft. gravel} \\ \hline 8 \text{ cu.ft.} \end{array}$$

In other words the proportions used would have been 1:2:6 instead of the 1:3:5 specified.

C. CRETE.

Cleveland, Ohio, Jan. 25, 1912.

Destructive Action of Butter Oil on Concrete

Sir—An instance of the destructive effect of animal oil on concrete, which has come up in our practice, may be of interest to the profession.

Late in the fall of 1910 we completed a reinforced-concrete building, a part of which was to be used for the manufacture of process butter. In the manufacture of this butter it is necessary that fresh country butter gathered when there is an excess supply be held in storage until such time as there is a demand for the same, when it is placed in a large tank and melted. When melted to an oil it flows into cylindrical tanks with cone-shaped bottoms where it is "aërated" by having air blown through it.

These tanks are supported on reinforced-concrete beams and girders, and during the process above mentioned more or less grease comes in contact with the concrete. This apparently has caused the concrete to deteriorate, all the life being taken out of the aggregate so that it can be taken out of the beams and girders with the hands. This aggregate has the appearance of sand that is saturated with grease, and the grease apparently seems to penetrate right into the concrete, and on the level with the bottom of the tanks it has penetrated entirely through the outside wall of the building. The concrete in no other part of the structure shows any sign of deterioration.

The concrete is composed of clean, unscreened river sand and gravel, the proportions of this material being approximately one part sand and two parts gravel. With this unscreened aggregate was mixed portland cement in the proportion of four parts aggregate to one of cement.

We would be glad to hear of any similar experience, or of any way in which the concrete can be protected against this destructive action.

W. M. BRODE & CO.

Newcomerstown, Ohio, Jan. 12, 1912.

Data on the Deterioration of Cast-iron Mains

Sir—It may be interesting to some of your readers to know that a few weeks ago, in taking out a section of an 8-in. water main in order to insert a T branch, the pipe was found to be almost as good as new after 17 years of continuous service. There was a very slight trace of rust in two narrow irregular streaks and two or three very small buttons hardly as large as apple seeds. Here is a case where the usual coefficients of deterioration, which are given by several authors well known to hydraulic engineers, would not apply.

It is proper to state that this pipe was

furnished in 1893 by the McNeil Pipe & Foundry Co., of New Brunswick, N. J., before the days of the great pipe combination; that it was furnished on specifications and tested, and passed the eye of an inspector as it was unloaded. It was required to be coated with Angus-Smith coating applied in the usual way. The purchasing company had no inspector at the works.

The pipe passed inspection so well that the amount rejected was but a few hundred pounds in a contract which called for enough to lay 6½ miles of main and distribution lines. On another occasion, some four years ago, a number of lengths of 8-in. pipe were dug up and relaid in order to lower the grade. These were found to have nearly as smooth interiors as when laid. On other occasions, when unusually large connections have been made, so far as could be seen for a short distance either way, no material rusting or incrustration has ever been found.

The water comes from a large storage reservoir among the hills and is entirely surface water collected from a drainage area of about two square miles. It is distributed through the pipe system under pressures varying from 60 to 100 lb. to a square inch. During the first few years it carried considerable dissolved organic matter, according to analyses made by the State Board of Health.

If many of your readers can furnish equally good records for pipe in service toward a score of years it would appear that some of the coefficients of deterioration in vogue for cast-iron pipe are probably too large.

ROBERT FLETCHER,
Director, Thayer School of Civil Engineering; President and Engineer, Hanover Water Works Co.
Hanover, N. H., Jan. 12, 1912.

Corrosion of Steel Rods in Reinforced Concrete by Salt and Calcium Chloride used in Mixing

Sir—In reference to the query of W. J. R., in your issue of Dec. 28, p. 779, relative to the effect of non-freezing mixtures on reinforcing metal in concrete, the following observations were made during 1908-09, by B. Knowles and myself.

Tests were made to determine the relative effects of various percentages of sodium chloride and calcium chloride on reinforcing steel embedded in concrete. Two aggregates were used; first, a 1:2:5 mixture and, second, a 1:2:3 mixture determined by mechanical analysis of the materials to give the densest aggregate. In these proportions aggregates containing 0%, 0.5%, 1% and 1.5% by weight of salt and calcium chloride were made up. With each, specimens were made in three consistences, dry, medium and wet. All materials were apportioned by weight, thoroughly mixed and rammed in thin layers. In order accurately to determine the effect per square inch of surface it was necessary to use 1-in. round bars.

The steel was carefully cleaned, weighed and measured and placed in a 6-in. cube of concrete to conform as nearly as might be to the ordinary position of reinforcing. The test cubes thus prepared were exposed to the elements for eleven months. At the end of this time they were broken and the bars were again carefully examined, cleaned and weighed.

A significant point in the results observed is that specimens in aggregates prepared without the use of salts, showed neither change of appearance nor loss of weight, while those prepared with salts all showed rust, and most of them greenish or black pits and loss of weight after cleaning. The material from these pits, a soft graphite-like mass, proved on analysis to be ferrous chloride. This was particularly noticeable in the aggregates containing 1.5% calcium chloride.

From a study of the observations and tabulated weighings the following conclusions were reached, viz.:

One. The presence of NaCl or CaCl in the aggregate causes a corrosive action on metal.

Two. This action is greatest on the under side of the bar.

Three. This action is greater in concrete of dry consistency than in one of a wet consistency.

Four. The denser the aggregate is proportioned the less the action.

Five. The corrosion increases with an increase of percentage of the salt in the aggregate.

Six. The action caused by calcium chloride is greater than that caused by common salt.

It was beyond the scope of the experiment to ascertain whether the action noted would continue until the effective strength of the steel would be dangerously impaired. But the effects as stated above were conclusively demonstrated.

CLIFTON P. MAYFIELD,
Office, Division Engineer, Pennsylvania R.R.
3rd and Powelton Ave., Philadelphia, Penn.
Jan. 18, 1912.

More Concerning Engineers' Unions

Sir—I agree most heartily with "A. B. C.," in your issue of Jan. 11. No doubt we need something and some sticking together, but let's not descend to the plane of the labor union to solve our problems.

The situation rests largely with us. We can decline to do a certain class of work for less than what we think right for the work in question. If the employer takes a "new born" graduate at a reduced price he is apt to pay the difference in cost one way or another. Get our new-born brothers not to accept too much responsibility for too little pay just to get the experience and I think we have the problem solved. Do not make an important survey and sign your name to it for reputation's sake. Get the money and all it is worth.

X. Y. Z.
Charleston, S. C., Jan. 17, 1912.

More Concerning Engineers' Compensation

Sir—I have read with much interest A. B. C.'s letter, "Should Civil Engineers Organize a Union?" in ENGINEERING NEWS of Jan. 11, and heartily indorse his views on the subject. Any organization which tends to oppress the weak rather than to strengthen them must needs become a failure.

Permit me to say a few words for the salaried men employed by engineers. If young graduates who advertise that "a steady job is wanted rather than good pay," should be marked men and denied admission later to any technical society, what should be done with engineers who advertise for experienced help, giving a long list of the required qualifications, and then offer a salary below the wages of an unskilled day laborer?

The same engineers who are constantly complaining about inadequate compensation are often those who would rather employ an incompetent man at starvation wages than pay a little better salary to an ambitious young engineer of good technical education though limited experience. The opportunity for gaining practical experience may justly be regarded as a part of the compensation, yet the theoretical knowledge obtained by several years' hard study should entitle the employee to better pay than an apprentice of whom no previous knowledge of the trade he is going to learn is required.

The lowest salaries are paid to employees in the engineering departments of corporations where the rates often depend only upon the proper representation to the managers by the engineer in charge. It would really be very interesting to get some true statistical data about the percentage of college graduates employed by corporations, and their average salaries 5, 10 and 15 years after graduation. I do not believe that these figures would be very encouraging for young men taking up engineering as a profession, and engineering should be a profession.

O. C. K.
Jackson, Miss., Jan. 14, 1912.

Sir—I was interested in the inclosed two letters, recent correspondence between a young man, and a civil engineer

who is a member of the American Society of Civil Engineers. Perhaps you would like to place this "live sample" before your readers.

G. M. P.

Brooklyn, N. Y., Jan. 16, 1912.

[We print the principal part of the letters referred to below.—ED.]

My Dear Cousin:

I would like to ask you for some advice. What chance is there nowadays for a civil engineer? For this purpose, the best thing to do is to tell you my attainments. In the first place, I adore mathematics, and am quite a good hand at it, so my teachers tell me. I am a senior now, and am preparing for the Mass. Institute of Technology, but I am undecided whether to go to college or prepare for a commercial life. I have always had in mind an engineering course, but my father is a strong advocate of business, so it leaves me in a quandary.

Dear Cousin:

Your father is not opposed to education, and would sacrifice a great deal to see you the leading engineer of the profession, but would your abilities and mathematics and education and training suffice? We are yet far from that stage of sociological development when individuals are appreciated according to their intrinsic value to the community, and it is not the best that gets the best.

Of course, I do not know what is your ambition in life and what particular "chance" you are in quest of; but I would guess that you are referring to the money-earning capacity, and in that case my reply is not evasive: "The chances of a graduate and brilliant civil engineer to achieve financial success are so small as compared to the world-wide opportunities of an intelligent business man that there is no room for doubt as to the choice."

I have hesitated to put my advice in writing, as the topic is rather one for a lengthy talk. So many factors bear upon it that a direct reply from the data you have furnished is well nigh impossible. But a good judgment and a friendly mind would firmly repeat: "Keep off! Keep off!

[It seems worth while to note the fact that engineers are, after all, far better off in the United States than in Europe. We find in the London correspondence of *The Indian and Eastern Engineer* the following.—ED.]

A correspondent of the "Electrical Review" applied for a post as "meter tester and testing assistant" in the Midlands. The qualifications required for a wage of 26s. [$6.35] a week (less than the pay of a day laborer or charwoman) were as follows:

The candidate must be not less than 19 years old (he would have to be at least 29 to fulfill all the requirements) and must have successfully passed through a complete course of theoretical and practical training in a recognized technical school or college, gained a certificate or diploma, and have had some experience in a works of good standing. He must be thoroughly experienced in testing and adjusting meters, indicators, and apparatus of all types, and of calibrating, checking and maintaining accurate all the electrical apparatus in the works; and able to localize faults on mains and to test insulation during working, besides investigating complaints. He must be ready to assist the mains superintendent in technical matters, and act for him in his absence, and must be a fair draftsman, quick at figures and able to use logs and the slide rule. Moreover, besides taking charge of the test-room and maintaining its contents accurate and in good order, he will be required to show a thorough knowledge of all branches of d.-c. and a.-c. testing, and must possess sufficient mechanical knowledge and skill to repair instruments and meters.

Talk about sweating the poor working man, why, it's not in it!

The Behavior of Water in Advance of a Steamboat

The recent collision between the "Olympic" and the "Hawke" has aroused considerable interest among engineers, and has brought to light many observations that have been appearing in the periodicals for some little time past.

These things are not necessarily discoveries, but, rather, "buried knowledge"—things that have been seen so often and have become so familiar to the people who have lived among them that they had come to believe them to be known equally well to everyone. It is the same with many things in the engineering line; occurrences become so familiar that their importance is not appreciated.

On the Niagara River, at Buffalo, New York, there is a ferryboat that has been running between the foot of Ferry St. and the little town of Fort Erie, Canada, for many years. Every time this ferryboat approaches its dock on the Canadian shore it causes a peculiar action of the water in its immediate vicinity.

The water immediately offshore is very shallow, the depth reaching probably 4 ft. at a distance of about 50 ft. out. At this point there is a very steep bank, and in the next few feet out from the shore the depth of the water increases very rapidly so that the dock did not have to be extended very far out, as the boat could run right along the edge of the deep water. There is considerable current in the deeper part of the river just outside the dock, but on the "shelf," where the water is only 4 ft. deep, there is very little current owing to a projecting ice-breaker farther up the river.

As the ferryboat approaches the dock, heading up the river as it always does, the water on the shelf begins to recede from the shore, the motion becoming faster and faster until the shelf is practically dry. So dry, in fact, that the children used to (and probably do now) run out from the shore after the water a distance of about 40 ft. They would be driven back by the wave which followed the boat and which would carry the water farther up on the beach than it was before. This same phenomenon occurred with either a stern-wheeler (screw propeller) or a side-wheeler.

In the Erie Canal it has often been noticed that just before the approach of a tug or other rapidly moving vessel the water would fall away from the bank on both sides, and if boats were moored at the bank, they would strain at their lines, tending to recede from the banks, but returning with a bump as the steamer passed. A person on the bow of the tug moving along the canal could follow the wave of falling water level, which kept about the same distance ahead of the tug at all times when the width of the canal was constant.

In the case of a boat moving along a canal which is so small that the boat fills a considerable portion of the cross-section, a curious effect is observed. In a case the writer has in mind, the canal was very shallow, probably 4 ft. in depth, while the draft of the boat was about 3½ ft. The canal was about 20 ft. wide, the boat about 4 ft. The same effect of the wave of receding water-level ahead of the boat was observed, but the curious circumstance was that it was almost impossible to run the boat into the bank when traveling at speed.

The boats used were electric launches and capable of considerable speed. The experiment was tried repeatedly of throwing the rudder hard over while the boat was traveling at its highest speed about 3½ or 4 ft. away from the bank and parallel to it, but other than a slight swerve toward the bank at first, and then away from it, there was no effect. The boat did not rub along the bank under these conditions, but rather seemed to sheer off.

J. L. JONES,
Assistant Professor of Mechanical Engineering, Oklahoma Agricultural and Mechanical College.
Stillwater, Okla., Dec. 26, 1911.

Concerning Part Time Schools

Sir—In the discussion on the subject of technical education between yourself and R. T. Crane, it seems unfortunate that neither of you (so far as I have seen) has referred to one of the greatest of educational discoveries, which might well serve as a compromise between your two apparently irreconcilable views. I refer to the systematic alternation of study and work, usually a day of each at a time, as practiced by a number of our newer and more progressive educational institutions, and, if I am not mistaken, by one or more of our great industrial corporations.

Crane's idea seems to be to work full time and crowd a little theory in at the expense of needed rest and recreation. Your idea seems to be to study full time for four years and then to work full time for the rest of one's working life.

It seems to me that education may be well likened to *concrete*, the theory being the cement and the practice the sand and stone. Crane would mix his materials thoroughly, the learner studying at night the theory applicable to the work he had

done during the day; but his mixture would in most cases be lean and lacking in cohesion, because the average boy's brain cannot work to advantage when his body is tired out by a day's hard labor.

Your mixture would have plenty of cement, but it would be very poorly mixed; for it is only by exceptional powers of memory and association that paper knowledge acquired years ago can be adequately applied to practical situations met with today. Theoretically it is possible to dig up and retemper cement that has not too firmly set, and mix it with more sand and stone; and the mixture has certain special and valuable properties, such as increased adhesive powers. But the process is expensive and difficult and on the whole not to be compared as to efficiency with getting the materials put together right in the first place. So the learner who, under efficient guidance, alternates study and work, theory and actual productive application (preferably on alternate days) acquires a grasp on both principles and facts not to be had either by work alone, however systematized; or by study alone, however intense and well directed; or yet by both, when for long periods one is pursued to the exclusion of the other.

Moreover, it has been found that boys who work and study alternate days progress in their lessons almost as fast as those in the same classes who study five or six days a week; and it is probable that their work in the shop is likewise more creditable than that of the full-time workers.

Of course, both your plan and Crane's have the temporary advantage over the one I advocate, that there are few places today where one can thus divide his time; whereas full-time schools and full-time shops are everywhere. It is also true that on the one hand Crane's plan has been brilliantly successful in many individual instances, young men of strong will and vigorous constitution having been able to hold their jobs through the days and concentrate their minds on their books through the nights. And it is true that on the other hand some few minds can carry book knowledge unused for years and instantly apply it when wanted. The point is, however, that, in education, as in every other branch of endeavor, we want methods that can be *depended on* to produce the best results in practically every case—not one brilliant result to a dozen or a hundred partial or complete failures.

As to the failures: Everyone knows with what contempt "practical men" regard the college trained; a contempt which is not altogether envy of superior attainments, and which would be swept away in short order (instead of only slowly disappearing as it is) if the typical graduate could only properly apply his never fully comprehended and half-forgotten theory.

And as to Crane's plan of out-of-hours study, I have myself been an out-of-hours student and have had sense enough to quit, realizing, as the great majority fortunately do before it is too late, that habitual overloading is even worse for the living organism than it is for the inanimate machine.

I have been a night-school teacher and noted the great and progressive loss in attendance, and the infinite toil and pitifully meager gains by those who persisted. And I have as a physician seen the alcohol and drug addictions, and the insanity, and the tuberculosis, resulting from o'erleaping ambition.

For *all* normal individuals there is needed for physical, mental and moral health, a suitable alternation, at frequent intervals, of productive work, eating and sleeping, play, and study. The proper proportion varies, of course, with age and condition, but no one of these elements can long be neglected without detriment to the individual and loss to society. The universal application of this rule may be left for the millennium (which may be nearer than some think); but we are here concerned with its application to the needs of technical students; and we seem to be on the eve of a great and general advance, along this line, in education.

NORMAN ROBERTS,
Passed Assistant Surgeon,
U. S. Public Health and
Marine Hospital Service.
Washington, Jan. 12, 1912.

[We have given much space in ENGINEERING NEWS to the coöperative educational system as developed at the University of Cincinnati in its mechanical-engineering course, and at the Fitchburg, Mass., high schools. We have hitherto expressed hearty approval of the principle of combining practical work with study; but some of the advocates of these schemes have made the very error of overworking the students which our correspondent so explicitly condemns.—ED.]

Some Computations to Determine What Interest Macadamized Country Roads Pay on Their Cost

Sir—Will you grant me some of your valuable space to contribute, on the minority side, to the discussion now going on as to the improvement of public roads, and particularly as to federal aid for this work.

A great wave of socialism, collectivism or anti-individualism—it may be called by any of these names—is undoubtedly sweeping over this country and indeed over the world. It has submerged already a large part of our press and even where we might naturally look for discrimination, fair consideration of both sides and a higher view than prevails among the masses, viz., in our technical journals, there is an intolerant upholding of socialistic or anti-individualistic ways of doing things which needs, in the writer's humble opinion, to be combated as vigorously as possible. ENGINEERING NEWS has, up to the present, been at least fair to individualism and has, on certain occasions, argued in its behalf in unmistakable terms and in vigorous language.

When a writer of Mr. John C. Trautwine, Jr.'s, standing and ability proclaims that Utopia is at hand and that the very simple step of letting the government do everything, since it can easily surpass one man in efficiency, is the only step that need be taken to reach that land—when such a man so expresses himself, things are indeed in a serious condition.

In passing, I would say that "Trautwine" was not written by a committee of Congress or any other governmental agency. And "Trautwine" has done an immeasurable amount of good in the world.

In the solution of the good-roads question, a rational method of procedure would be to consider first the traffic the road has to carry, in the same way that the first step in bridge design is to consider the load the bridge has to bear. Not much has been done along this line and what has been done has been *after* beginning to improve the road. That is to say, the decision has been reached to improve, and improve up to a certain standard, before any traffic counting has been done.

The writer has been unable to gather much information on this point, but the following is offered partly compiled, partly from his own inquiries. Travel on highways, country roads: New York State, four roads, average 131 vehicles per day (*Eng.-Contr.*, Apr. 21, 1909); Illinois, eight roads, average 251 vehicles per day (*Eng. Rec.*, 1907, p. 356); Massachusetts, two roads, 250 per day; Ohio, one road, 248 per day (*Engr.-Contr.*, Nov. 2, 1910). These four instances may, perhaps, fairly represent country-road travel in the densely populated part of our country, though not, of course, the densest travel to be found in that territory. In Tennessee one road has 60 vehicles per day, another road 33 vehicles per day.

In the case of the Ohio road referred to above, the separation into classes is given and I have computed that the percentage of the kinds is as follows: Wagon traffic, 28% of the total, the rest being pleasure vehicles: buggies, carriages, automobiles, motorcycles, etc. Of the 28% that are wagons, 8% are two-horse wagons and 20% one-horse. Applying this percentage (and I apply it only for lack of a better and more accurate) to the average traffic of the four states (N. Y., Ill., Mass. and Ohio), 218 vehicles a day, we see that there would be 17 large and 44 small wagons per day carrying goods passing over the road.

Now in its economic aspect—and that is the only one I am considering at the moment—what saving would probably result from improving these roads, considering them as earth roads before improving and macadam afterward? The loads hauled in these wagons may be estimated at an average of one ton for the two-horse wagon and one-half ton for the one-horse wagon, considering that in both cases many wagons would be empty. This makes 39 tons of freight per day. But for a large part of the year, that is, during dry weather, the earth road is practically as good for the small loads hauled as the hard road. What, then, is the proportion of days in the year when the weather is bad or rainy? In *Engineering and Contracting*, Dec. 6, 1911, p. 597, is an article giving the average number of days in the year in which there is a rainfall of 0.01 in. or over as 133, and the number in which the rain is "enough to stop work" as 66.

Using the latter as representing the number of days the roads would be muddy, the annual tonnage to be hauled over muddy roads would be 2574, assuming there was no choice as to the days when hauling would be done.

As to the saving per ton-mile, I take from a paper by Prof. I. O. Baker in "Proceedings of the Illinois Society of Engineers for 1901," p. 38, an average of three cases of hauling over unimproved roads. The result is 23.3c. per ton-mile, while for three improved roads it is 19.5c., a difference of 3.8c. per ton-mile. To save space, I do not give details. Call the difference, however, 5c. per ton-mile and the saving on 2574 tons is $128.70 per mile. Now deducting cost of maintenance of $70 per mile per annum (this being an average of three figures for local roads, viz., in France, Indiana and New York) the balance left is $58.70. From an article in *Engineering and Contracting*, Dec. 23, 1908, the average cost of constructing macadam roads in 15 states is $5289 per mile. The above estimated saving is *slightly over one per cent.* on this amount. But interest on the cost of the roads would be from 3 to 5 per cent. The above is based on traffic statistics from states where the average traffic is 218 vehicles per day. In this state (Tennessee) the traffic as given above is only 46 vehicles a day. If, then, the National Government were to do the road building, its engineers would be likely to import into some localities more expensive methods of road building than are warranted by the local conditions. Besides, these Tennessee traffic figures are for some of the best counties in the state; in poorer parts of the state the traffic may be much less.

But now having estimated above the saving in transportation on good over bad roads, let us look further into this and see if even this saving really exists for transporting *farm products*. The supposed saving in hauling by good roads is due to larger possible loads. In Tennessee the average size of a farm is 90 acres, the average production of corn and wheat is 800 lb. per acre, or 72,000 lb., or 36 tons to the farm. Now, if over unimproved roads two tons per day could be hauled, that would be 18 days' hauling for each farm, if every acre on it were cultivated, and if every bushel raised on farm were hauled to market or, counting two men to the farm, it would be nine days' work to each man, or less than one day a month. The average farm hand might want to go to town oftener than that just for diversion, so the larger possible load would not induce a larger average actual load.

All this argument has been based on local traffic and farm traffic. But what of long-distance highways; for instance, the one proposed across this state from Memphis to Bristol, 500 miles? Counting the cost of hauling on improved roads as low as 15c. per ton-mile, and the cost of railroad freight as high as 1c. per ton-mile, the difference is 14c. per ton-mile, and on this 500 miles the difference would be $70 per ton in favor of shipping by rail. Thus, a ton of lumber, for example, hauled from Bristol to Memphis, would cost for hauling over the road $75, while shipped by rail its transportation would cost $5.

These long-distance routes, therefore, are meant for touring automobiles, and they should be paid for by automobilists, and not by taxing the general public and especially the farmers.

The foregoing argument has been based on average figures; but roads built under government supervision may cost almost any price. The roads in Porto Rico cost $15,000 and even $20,000 per mile. Brick county roads are now being built that cost $22,000 per mile. There is little to prevent a $22,000 road being built where the whole traffic is 30 vehicles per day, once the movement for construction by National authorities gets fairly started. Some river improvements already made prove this.

Let us have better roads; let those who benefit by them pay for them; let there be toll gates along the roads, so those who benefit must pay; let our common roads be improved gradually by the localities (mainly) that they are in; then justice will be promoted and the character of the men who travel over the roads will be improved as well as the roads, and we shall have less of the "to hell with who it hurts" policy.

A. P. C.

Nashville, Tenn., Jan. 9, 1912.

[We give space to the above letter for its presentation of methods and figures in the consideration of road economics, in place of the vague generalities which are the staple of "good-road" literature; but the figures used by the writer are, in some instances at least, wide of the mark. His estimate of the cost of maintenance of macadamized roads, especially, is only a small fraction of the actual cost wherever automobile traffic is to be reckoned with, and that is everywhere nowadays.

In round figures, at least $10,000 per mile for construction and $1000 per annum for maintenance must be assumed to build a bituminous macadam road and maintain it at the present day in view of the rapid increase in heavy automobile trucks. At 4% interest, this means an annual charge to the traffic passing over the road of $1400 per annum.

It should not be difficult from a traffic census to get a fair idea of the tonnage of freight and number of pleasure vehicles which will use a road, making allowance, of course, for the large increase which will take place when the road is improved.

Regarding computation of the benefits from the use of a road, instead of taking the number of rainy days in the year, as does the writer above, it would seem more accurate in most sections of the United States to assume that for six months of the year an unimproved dirt road will be more or less obstructed by mud. The saving per ton hauled in clay sections where frost penetrates deeply during some three months of this time will be much greater than our correspondent assumes. Moreover, the community is generally willing to pay as much for good roads to drive buggies and automobiles on as to haul freight wagons on.

That there is need for caution in building roads (especially with borrowed money) more expensive than the taxpayers can afford to maintain is well understood by engineers who are carefully following the good-roads agitation. Such computations as are here suggested may be useful in indicating the wisdom of adopting gravel or sand-clay or use of the road drag to improve roads whose traffic does not warrant more costly methods.—ED.]

The Prest-O-Lite Building Failure

Sir—I have read with some interest the so called analysis of the Prest-O-Lite Bldg., by Mr. T. L. Condron. It seems to me that these figures are absolutely misleading. For example:

1. Can we seriously consider overstrain of partly cured concrete as having anything whatever to do with the stresses on the concrete when hardened?

2. In a failure which was evidently on the evidence of the photographs of the collapse a shear failure pure and simple, what has a computation for bending moment to do with the question of pure shear?

From this standpoint the mathematics presented by Mr. Condron appeals to the

TABLE SHOWING RESULTS OF FLOOR TESTS

	Date	Building	Column Spacing		Diag. span	Slab Th'k, in inches Max.	Min.	Ave.	Test Load Live load, lb.	Lb. per sq.ft.	Area, sq.ft.	Total load, lb.	Max. def., in.	Ratio def. to span	Remarks
Condron's Design	1909	Studebaker....	24′ 0″ × 23′	9″	33′ 9″	12	6	8.6	100	300	570	171,100	0.34	1/300	Test load on 24 hr.
	1909	Peck & Hills...	14′ 8″ × 14′	0″	20′ 3″	7½	4	5.7	150	280	196	54,800	0.06	1/400	Test load on 24 hr.
	1910	Oak Park W. H.	16′ 10″ × 15′	3″	22′ 8″	9	4½	6.5	150	300	256	76,800	0.08	1/300	Test load on five days
	1910	Peck & Hills...	16′ 2″ × 15′	10″	22′ 7″	7½	4	5.5	100	275	256	70,400	0.12	1/230	Test load on 24 hr.
	1911	Sharples.....	18′ 0″ × 17′	5″	25′ 0″	8	8	8	225	550	620*	34,400*	0.22	1/100	*Test load on 2 adj. panels for three days
Turner		Snead.....	22′ 6″ × 20′	0″	30′ 1″	7¾	7¾	7¾		392	430	168,000	0.44	1/80	
		Gallum.....	27′ 0″ × 17′	0″	27′ 0″	?	?	?		600			1.25	1/260	

writer as an absurdity. The imitation of a "mushroom" frame provided by the designer of the Prest-O-Lite Bldg. might be logically compared to the ribs of an umbrella frame in which the ribs are carefully hinged around the shaft of the column and with bracket parts not connected to the ribs in such a manner as to fix the ribs so that they will not close down around the stick or shaft just as an umbrella does when the umbrella is shut down.

In the above respect the Prest-O-Lite design differs from the true "mushroom" frame. In the former we have nothing left in shear but the value of partly cured concrete undoubtedly starting to thaw out and sweat, the few small rods which pass over the column presenting little stiffness or rigidity in themselves.

A standard mushroom frame would carry by the stiffness of the steel alone, after the concrete had entirely sheared through, the loads brought upon the head of the Prest-O-Lite Bldg.

It seems to the writer that the trouble with the majority of concrete engineers and textbook writers on the subject of reinforced concrete is that they try to exhibit too great a familiarity with mathematics and too little familiarity with the ordinary common-sense principles of design with which the engineer only becomes familiar by keeping in close touch with construction work. When those who profess to be concrete engineers pay more attention to actual construction and less attention to pure mathematics based on assumptions there will be fewer records of failures in the technical journals.

Let us discuss this question of strength of flat-plate floors in the light of actual experimental data:

The Snead Mfg. Co. building, Louisville, Ky. Panel, 22 ft. 6 in. by 20 ft.; test load, 392 lb. per sq.ft., or a total load of 83.8 tons; deflection, 7/8 in.; thickness of slab, 7¾ in. It might be noted that the 7/8-in. deflection in this building does not indicate any overstrain of the materials.

This may be brought out very well by a test made in the Gallun Tannery building: Test, 600 lb. per sq.ft.; panel, 17 ft. by 21 ft.; tested to 1¼-in. deflection; reinforcement, seventeen ⅜-in. rounds in each direction; elastic recovery after test.

Now if we should get busy figuring on bending moments, as Mr. Condron has done, we should have some very absurd results. He evidently fails to consider that the bending moment is resisted more largely by circular than by radial stresses. The circumferential distortion is $6^2/_7$ times as great as the radial, and the circular rings and rods in four directions around the "mushroom" head (or in some of the later constructions a flat spiral) form a most efficient means of resisting these stresses and upset entirely the method of computation presented by Mr. Condron.

The assumption that the second floor of the Prest-O-Lite building was in any measure thoroughly cured, does not seem to be borne out by its deportment. It was undoubtedly stiffened up by cold, and thawing out temporarily weakened the slab in shear and it failed by shear around and near the column just where the "mushroom" frame would have given it strength had it been properly designed.

The writer's preceding remarks as to the closing down of an umbrella illustrate more clearly than any description he can give the probable action of the so called spider introduced in the design of the Prest-O-Lite building as a substitute for the rigid and safe "mushroom" head used in the standard Turner construction.

C. A. P. TURNER.

Minneapolis, Minn., Jan. 15, 1912.

[The above letter was submitted to Mr. Condron, and we have received from him the following reply.—ED.]

Sir—I have read the proof of Mr. Turner's communication. My report was not made upon one of Mr. Turner's designs, nor have I criticized his special form of construction. I call attention, however, to the fact that the temperature record accompanying my report on the Prest-O-Lite failure shows that the concrete of the second floor had over three weeks of excellent weather for "curing," besides an additional three weeks of fair "curing" weather, so, that, to use Mr. Turner's own term, the concrete should have been "cured" of anything short of a fatal malady. I am informed that the tests made on the concrete of the second floor show the concrete to have attained more than sufficient strength to resist "safe working stresses."

I do contend that reinforced-concrete designs should be calculated upon simple and rational bases that do not involve mysterious nor inexplicable functions, so that any intelligent engineer may check such designs, as is the practice in every other branch of structural engineering. No one of us should claim a monopoly on intelligence or on ability economically to design. Stresses due to both moments and shears should be determined and provided for. In the case of the Prest-O-Lite building the unusually large column heads and the thickness of the second-floor concrete slab makes it improbable that the failure could primarily have been due to shear, although in the final collapse the concrete, of course, sheared, and even a "mushroom" head would not have held it up.

I am content to let the analysis offered in my report speak for itself and leave your readers to decide for themselves whether or not the results are "absurd." They may also puzzle out, if they can, the meaning of the statement, "the circumferential distortion is $6^2/_7$ times as great as the radial."

As Mr. Turner asks me to discuss the "question of the strength of flat-plate floors in the light of actual experimental data," and cites two tests on his own designs, I may add my mite to those data in the form of the accompanying table, and trust that others may see fit to contribute similar data.

It will be observed that the deflections reported by Mr. Turner are from one-half to five times as much for similar conditions as the deflections recorded for tests on the writer's diagram. Mr. Turner's statement regarding the Gallum Tannery—"elastic recovery after test"—is very indefinite. It would seem quite certain, however, that a deflection of 1/260 of the diagonal span would produce cracks in the *upper* surface of the floor, near and between the columns, and that there would be an appreciable permanent set and the materials would be overstrained. I appreciate Mr. Turner's compliment in classifying me "with the majority of concrete engineers," although I cannot claim "too great a familiarity with mathematics," not being familiar with Poisson's ratio. Having devoted a large portion of the past few years to designing and superintending concrete work, I have perhaps absorbed some of the "common-sense principles of design with which the engineer only becomes familiar by keeping in close touch with construction work."

T. L. CONDRON.

Chicago, Ill., Jan. 25, 1912.

NOTES AND QUERIES

"Assistant Engineer" is informed that letters must be signed with the writer's name in order to receive attention by the editors.

Issued Weekly by
The Engineering News Publishing Company
JOHN A. HILL, Pres. CHARLES WHITING BAKER, Sec'y.
ALFRED E. KORNFELD, Vice-Pres. W. W. MAYER, Treas.
GEORGE H. FROST, Chairman Board of Directors.
505 Pearl St., New York.
1138 Monadnock Block, Chicago.
Home Life Building, Washington, D. C
Z. P. Maruya & Co., Ltd., Tokyo, Japan.

CHARLES WHITING BAKER, M. N. BAKER,
E. E. R. TRATMAN, F. E. SCHMITT,
Editors.

Subscriptions payable in advance, $5.00 a year for 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii, or the Philippines, $7.00 in Canada.

To foreign countries, including postage, $9.00 or its equivalent, 36 shillings: 36 marks: or 45 francs.

Notice to discontinue should be written to the New York Office in every instance.

Advertising copy should reach New York Office by Thursday of week before date of issue.

Entered at New York Postoffice as mail matter of the second class.

CIRCULATION STATEMENT

During 1911 we printed a total of 931,958 copies.

Of this issue 19,000.

None sent free regularly, no returns from news companies, no back numbers kept beyond current year.

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Engineering News

A Proposed Bureau of Public Utilities for Pittsburg

Among the many interesting reforms under way or proposed at Pittsburg, Penn., is the proposition recently made by William A. Magee, mayor of that city, to the effect that the council appropriate money to establish a bureau of public utilities. Such a bureau would regulate the public-service companies operating within the city.

It is well known that state public utilities commissions are now the rule rather than the exception, but it is not so well known that a considerable number of cities have similar regulating bodies. Kansas City, Mo., and Los Angeles, Calif., were, we believe, the leaders in this respect, but since these cities established public-service bureaus a dozen others have taken the same step. We do not question but that there is a proper field for local bureaus of this kind, but probably most of the work of regulating rates, as well as some other matters that may come up for settlement, can better be handled by state utility commissions than by city commissions. There are, however, a multiplicity of purely local questions coming up in any large city which demand immediate attention and can best be handled by a local body, without the necessity of calling in a state commission, which might perhaps better be engaged with broader questions.

Co-operation between Communities and Colleges

In a few of the most important cities are institutions which may be truly called "city colleges," since they are supported, at least in part, from the city treasury, like the public schools. While all educational institutions have the duty of rendering public service, these city colleges especially have the duty of promoting the welfare of the city of which they are a part.

Two instances where this obligation has been recognized in an important way have recently come to our notice.

A few days ago, Mayor Hunt, of Cincinnati, Ohio, recommended to the council of that city that it should turn over to the University of Cincinnati all the chemical and engineering testing of the city. He also recommended that steps be taken to extend the coöperative courses of the university (about which so much has been said in the past few years) so that groups of students would alternately work under the various city departments and study in the college class-room.

The plan will be formulated in an ordinance which is to be submitted to the city council. Under this plan the university is to conduct the tests required by the city engineer to determine the quality of material furnished the city under various specifications; the city chemist and chemical laboratory will be transferred to the university; the allowances in the city engineer's budget for testing purposes will be transferred to the university, which will hereafter prepare a yearly estimate of its needs for such work; the university will coöperate with the city engineer in the preparation of specifications and will carry on research work in paving materials and in any other fields where effort may be advisable from time to time.

The coöperative-course scheme proposes to take students from the university and put them under a part-time plan in the various city departments, in much the same way in which the university has placed its students in the manufacturing establishments of the city. It will be recalled that the same instruction in a given subject is given alternately to two groups of students, one of which is spending a week in the shop and others a week in the class-room. The faculty hopes in this way to give the students desirable experience in municipal engineering, and the mayor hopes to build up a permanent corps of high-grade employees in the various city departments.

President Finley, of the College of the City of New York, has recently outlined a plan to help city employees who wish to prepare themselves for advancement in some line of municipal service. Special courses are to be arranged particularly for mature persons who may enter the City College by taking entrance examinations to show the proper preparation for the desired work. They must take a minimum of five hours a week in languages, mathematics, natural history, philosophy, physical instruction and hygiene, chemistry, physics, or political science. The stated aim of the new work, or rather this extension of an older work, is the training of a civil employee before he secures advanced appointment, rather than afterward and at the expense of the public work. It was noted above that these special courses are but the extension of older work of the college, for there are already registered some 500 students taking various special courses, and 2200 school teachers preparing for promotion.

State universities which are seeking to enlarge their field of usefulness may well turn their attention to the plans announced above. Much of the peculiar success of the University of Wisconsin has been due to just this sort of coöperation between the university and the state government.

A Notable Paper on Sewage Disposal in England

A notable paper on sewage disposal was sent to the recent conference on water pollution, held in Baltimore, Md., and reported in our issue of Dec. 21, 1911. The paper was prepared by John D. Watson, chief engineer of the Birmingham, Tame & Rea Drainage Board, which is responsible for the sewage-disposal works of Birmingham and a number of adjacent towns. The greater part of the paper is reprinted elsewhere in this issue.

The paper is interesting and short enough to be read by anyone in a few minutes, so it is unnecessary to outline its contents here. We wish, however, to call attention to one or two of its most notable features. The first is one of the statements concerning the way in which Birmingham and vicinity was hurried on to make large expenditures for sewage farms just at the time when the Royal Commission on Sewage Disposal had been appointed. Very soon afterward scores, if not hundreds, of British municipalities in England and Wales were relieved of the necessity of providing land for the final treatment of sewage wholly regardless of all local conditions. The purchase of more land for sewage farms in Birmingham was largely due to litigation brought by a rural district named Tamworth to prevent the alleged pollution of the River Tame by the sewage from the works of the drainage board. It is a notable fact that the rural district itself during the prosecution of this suit, which continued over a number of years, was doing nothing whatever to prevent the pollution of the River Tame by its own people. In this respect the case is not without parallel in our own country.

Another feature of Mr. Watson's paper to which we wish to direct attention is his statement to the general effect that if the pocketbooks of taxpayers were inexhaustible, it might be very well indeed to insist on sewage purification by every city to such an extent as to convert the sewage into drinking water; but, as Mr. Watson well adds, the taxpayers' pocketbooks are not unlimited in their contents, so cost has to be considered.

Mr. Watson says further that it would probably cost less to remove 93% of the impurity from the sewage in Birmingham than it would to extend the removal of the impurities by another 5%, so as to bring the total purification up to 98%. This is a point which might be given attention by some of the American anti-pollutionists who are now making such radical demands for the purification of all sewage, quite regardless of local conditions. As Mr. Watson well said, toward the conclusion of his paper, each sewage-disposal case should be considered on its merits, taking into account the pollution to which the stream receiving the effluent is liable from street washings, arable lands and other sources. He does not despair of seeing in England a river authority for each river, which shall have full control of sewage disposal and be authorized to say how much purification shall be demanded of the town at the head of the stream as well as the one at the foot on a broad estuary. Such an authority would also say how the cost of purification should be distributed or allocated between all of the municipalities on the drainage area. This point is well worthy of consideration by Americans as well as by British cities. Under special conditions it may often happen that a given city might well be released from expensive purification works, for instance, and be required to contribute to the cost of water-purification works; or a city below might be required to pay a portion of the cost of the sewage-disposal works of a city above, in order to protect its water supply.

The Folly of Restricting Public Appointments to Citizens

A vicious bill of direct interest to engineers as well as other professional men has been introduced in the New York legislature. It prohibits appointments to state, county and municipal offices of any person who has not been a citizen of the state for a year, and apparently goes so far as to require county or municipal residence for a year before appointment to offices under minor civil divisions.

A more pernicious blow to efficient state and municipal government is hardly within the power of the legislature to inflict. It is true that the enactment of the bill would only change what is already to a large extent an unwritten law to the force of a written law, but the change would nevertheless be one from voluntary to involuntary observance on the part of many state and municipal departments, while tying the hands of those who now exercise such freedom in the choice of officials as the legislature has left to them —which is none too great.

We do not need to point out to our readers that every state, county, city, town and village ought to be free to employ the best men available for any and all administrative offices or consulting positions which it is about to fill, quite regardless of the mere accident of residence. The real object to be obtained should be technical and administrative efficiency, and this is not a matter of state or municipal boundaries or citizenship.

We are pleased to see that an outspoken opponent of the bill is George R. Lunn, the socialist mayor of Schenectady, N. Y. We are also glad to note that the socialist administration of Milwaukee, Wis., has not hesitated to go outside its local boundaries for the director and some of the staff of its Bureau of Economy and Efficiency, and has even gone outside that state for consulting experts. Our pleasure in the Schenectady and Milwaukee cases is not because these are the acts of any particular party or school, but because men elected to office as a result of promises and hopes of reforms in municipal government are choosing wise and efficient means to carry out their promises and justify the hopes of those who put them in office.

Finally, does it never occur to the advocates of this short-sighted policy of restricting appointments to citizens that if a man from another city or state is appointed to office he at once or shortly becomes a citizen? Of course, citizenship or non-citizenship is not the real test. The object of all such restrictive legislation is to keep "jobs" for faithful political adherents—and to further this object your "good" politician would rather see an office filled with a local man of a different political party than by an outsider, who might, perchance, refuse to be decorated with the stripes of any clique or party.

Increasing the Dues in Engineering Societies

Ten years ago the governing body of the American Society of Mechanical Engineers asked the members of the society to adopt an amendment to the society's constitution increasing the annual dues. Opposition was at once organized among the membership, and when the proposition came to a vote at the annual meeting it was defeated by an overwhelming majority. At the annual meeting last December a second proposition was laid before the members, looking to an increase in the dues of the members resident in and near New York City. It was argued in favor of this proposition that these members have greater benefits from their membership by reason of the location of the headquarters there and it was also urged that the additional funds were needed to pay the expenses of the society's annual meetings held each year in New York City. The proposition was voted down, however, and will probably not reappear.

Another society is now attempting to increase its annual dues. The governing body of the American Institute of Mining Engineers has recommended an increase in the annual dues which will place them on a level with the dues charged by the other great national engineering societies. It recommends also an increase in the dues charged to members resident in and near New York City. Organized opposition to these changes is already manifested, and from present appearances the annual meeting which is

to take place on Feb. 20 will reject the proposition.

The only way in which the national engineering societies can induce their members to pay a larger rate of annual dues is by increasing in some way the service which they render to the members. One important change of this sort is the organization of local branches of the various societies, working where necessary in coöperation with existing local engineering societies.

Successful work of this sort has been done by the Canadian Society of Civil Engineers, but instead of taxing the members an additional amount for this added advantage the treasury of the national society bears a certain part of the expenses in connection with the local meetings. The same practice has been followed by the American Society of Mechanical Engineers, which is busily at work establishing local branches in various cities. The secretary of the society, Calvin W. Rice, spent last month making a tour over the country attending meetings of the local members of the society in Buffalo, Chicago, Cleveland, Pittsburg, Denver and San Francisco. The student branches organized by the society in the various schools of mechanical engineering have also been visited by the secretary, and the work of the society explained.

Work of this sort which tends to increase the interest in the society and stimulate accessions to membership is far more likely to increase the society's revenue and opportunities for usefulness than any attempt to raise the rate of dues with its inevitable result of resignations from membership.

A Chance to Save Money from the Refuse of New York City

With a pertinacity not readily explainable by a desire to serve the best interests of the city, New York has persistently failed to handle its garbage- and refuse-disposal problem in the light of a sufficiency of engineering evidence either at hand or readily obtainable. Years ago, the late Col. Geo. E. Waring made investigations which pointed the way to greater efficiency and economy in refuse disposal than has ever been attained, although the city has profited considerably by the data collected and the conclusions reached by Colonel Waring and his technical assistants.

Recent changes in the status of refuse disposal in America have made it readily possible for New York or any other American city to reduce the cost of refuse disposal to a small net charge, if not to make an actual profit which would help pay the cost of collection. Refuse incinerators abroad and at home demonstrate the possibilities of revenue from the heat of burning mixed refuse, where the conditions are favorable. An alternative plan is the recovery of grease and fertilizer base from the garbage, by establishing reduction works, and the recovery of salable paper, rags, bottles and various other materials from rubbish, with the burning of the unsalable combustible material, and the utilization of heat for power used by the sorting-plant and for other purposes.

Until Cleveland bought the privately owned garbage-reduction works of that city and Columbus built works of its own our cities were in the dark as to the costs and profits of garbage reduction. As a result, the private reduction companies, generally through the aid of political alliances, got a considerable bonus from the city, without much regard to the real need of it. Experience at the two municipal plants named indicates that private plants need little if any bonus—or would not if they were assured of contracts of sufficient length to warrant their heavy capital investment, and of freedom from political harpies.

To come back to conditions in New York City. Most, if not all, the local garbage-reduction contracts have been of altogether too short a life to result in anything like the *low* price to the company, or possible bonus to the city, which might have resulted under reasonable conditions.

As an engineering and business proposition, all political favoritism aside, the thing for New York City to do before letting another refuse-disposal contract, which we understand it must soon do, is either to ask bids for a long-term contract, under plans and specifications drawn by the best engineers in the country, or else to build and operate works of its own, also under plans and specifications as just stated.

Since the disposal of no one class of city refuse can rightly be considered without regard to its relation to the disposal of other classes, it follows that the whole refuse-disposal problem of New York needs exhaustive analytical study, by the best experts the country affords. No time should be lost in entering upon the investigation. We understand that such an expert investigation is favored by Wm. H. Edwards, commissioner of street cleaning, and it is to be hoped that it will be speedily authorized along well-conceived lines, by the Board of Estimate and Apportionment.

A valuable report on "Street Cleaning and Waste Disposal of the City of New York," was made on Dec. 31, 1907, by H. de B. Parsons, Rudolph Hering and Samuel Whinery (see our issue of Apr. 23, 1908, for lengthy abstract). The greater part of the report was devoted to street cleaning, and conditions have so changed since then that the subject of waste disposal needs re-study.

The Illinois Central Rear Collision and the Block System

The amazing thing about the recent rear collision on the Illinois Central R.R., in which its former president, Mr. Jas. T. Harahan, lost his life, is that there was not even the most elementary form of the space-interval system in force for the protection of trains.

This collision did not occur on a branch road in the country operating few trains on slow schedule. It occurred on the main line of the Illinois Central R.R. Co., one of the most prosperous of Western railways. This company, moreover, has for years used the block system in the district near Chicago, where a heavy suburban traffic is handled. What reasonable excuse it can have for continuing to operate fast passenger express trains on its main line with no other protection than the archaic old time-interval system passes comprehension.

We mince no words in saying that the continued use of the time-interval system by some of our most important railway companies, on lines of dense traffic, is the most disgraceful feature of American railroad practice.

It ought not to be necessary at this day to discuss the merits of the space-interval system and the inherent danger of the time-interval system; but the Kinmundy collision serves—for the thousandth time—to illustrate the latter.

The two trains which collided were scheduled to leave Chicago an hour apart, and by the time-table should have been half an hour apart at Effingham, the last stop before the place of collision. But in the severe winter weather that has prevailed, trains have been running far off the schedule, and, on the night of the disaster, by the time Effingham was reached the second train had nearly overtaken the train ahead. The second train was therefore held at Effingham for ten minutes before proceeding, under the time-interval rule. Notwithstanding this delay, it overtook and collided with the train ahead while the latter was taking water.

Newspaper accounts made much of the fact that this water-tank stop was an unusual one, there being a scarcity of water at another station on account of the severe weather. But unusual things are happening all the time in railway-train service. A system of train movement which does not protect trains moving out of schedule at any and all times is so inherently defective that it ought to be abandoned.

The railways are complaining—and with much reason—of the great amount of restrictive legislation and of state and federal supervision under which they must now do business. But to a very large extent they have brought this condition upon themselves.

Repeatedly, the Interstate Commerce Commission and the Block Signal and Train Control Board have urged Congress to enact legislation making the use of the block signal system compulsory. That recommendation is repeated by the latter Board in more urgent form in its annual report just issued, as shown by an extract from it, which we print below.

We deprecate the necessity for such legislation. It would be vastly better if the railways would of their own motion adopt the block system on all their lines where the traffic justifies it. But the conditions not only warrant but compel the recommendation for legislation which the Block Signal Board makes. Out of 240,000 miles of railway in the United States, only 71,000 miles were operated under the block system in even its most elementary form, a year ago. The increase of block-signal mileage in 1910 was only 5500 miles. Concerning this the board says:

> The increase in mileage indicated by the figures was practically all upon roads that already had the block system in use. The extension of the system to new roads—that is, to roads which had not before used the space-interval method of train operation—was not such as to warrant the belief that the block system will be brought into use generally within any reasonable period of time without governmental action compelling it.
>
> There is ample justification for such action when the number, and particularly the disastrous character, of the collisions which have occurred under the time-interval or train-dispatching system is considered, together with the small cost of installation and operation of a simple form of the block system, which would very materially diminish the chances of collisions due to defects inherent in the dispatching system. This is especially unfortunate in view of the repeated recommendations of the Commission to Congress for legislation requiring the gradual introduction of the safer method of handling trains which is afforded by the use of the space-interval system.
>
> These recommendations should have all the more weight owing to the fact that in the block system there is nothing new or untried, as it is in successful use on 75 important roads distributed throughout the country. All that the Commission has asked is that those roads which are now not using the block system should gradually conform to the practice of the roads that do use it.

We suspect, if all the truth were known, that it is the financial rather than the operating officials of our railways who are chiefly responsible for the failure of many important companies to discard the time-dishonored time-interval system and adopt the block system. And if the bankers and brokers who operate railways with chief regard to the effect of operations on the stock market will not be moved by anything but compulsory legislation, then compulsory legislation is certainly justified.

Membership Gradings in Engineering Societies

The directors of the American Institute of Electrical Engineers have laid before that society a proposal to establish among its members the grade of "Fellow." From one point of view, this is a matter of the society's housekeeping with which the outside engineering public has nothing to do. On the other hand it is generally agreed that the various engineering societies ought to learn from each others' experience; and particularly they ought to follow uniform practice in matters which affect their standing with the public. The proposition to add to the present list of engineering titles the designation "Fellow of the American Institute of Electrical Engineers," is, therefore, of interest and importance to engineers generally.

Moreover, questions as to membership gradations are being agitated in other societies, and are causing unquestionably some uneasiness, some jealousies and some dissensions. Discussion of the subject in an engineering journal, therefore, seems worth while.

There are two radically different plans of conducting a national engineering society. The first is to admit to membership in the society anyone of good reputation who is in any way connected with or interested in the branch of engineering to which the society is devoted, without question as to his professional ability or experience, or as to whether he has any more than a business interest in the industry.

The other is to fix a certain minimum standard which all applicants for membership in the society must attain to secure admission.

Great and influential engineering societies have been and are conducted on each of these plans; and there are strong arguments in favor of each. The tendency is, however, unquestionably toward the general adoption of the latter plan.

In most American societies of national scope, the general tendency is to establish such standards for admission that membership in the society shall be equivalent to a guarantee of professional standing.

But as any society must have a large membership in order to be strong and influential, it cannot confine its membership to the comparatively few who attain high professional standing. The societies which set high standards for membership, therefore, generally have lower grades to which those of lesser attainments may be admitted.

The chief motive back of all this, it must be freely admitted, is the desire to win professional standing for the sake of its effect on the public which employs engineers. The engineering societies of America have generally followed the example set by the British Institution of Civil Engineers. An English engineer, in order to have even a chance at important commissions, must be able to write M. I. C. E. after his name.

It has been the dream of many American engineers that membership in an American engineering society might also in time come to be recognized by the public as equivalent to a certificate of professional competence.

This is the real motive and justification for most of the work done in sifting applicants for admission to the societies and for establishing gradations in the membership.

We see little prospect that this dream is likely to be realized. The American public has not the deep-seated respect for professional titles that exists in Europe. The English or German engineer who writes a string of letters after his name, follows the custom of his country and is held in respect by reason of the distinctions thus expressed. But when the plain American, John Smith, writes A. M. I. M. E., or other cabalistic initials upon his business card, the American business man who hires engineers to work for him, is at once siezed with distrust of Smith's practical ability and common sense.

And there are sound reasons why the employers of engineers in America give scant respect to engineering titles of any sort. So far as college degrees are concerned, the practice of the various colleges has been so varied at different times and the number of colleges which have given degrees for a limited amount of work has been so considerable that few men of high standing in the profession ever care to write "C. E." or "M. E." after their names. So far as titles indicating engineering society membership are concerned; let us not forget that the public is densely ignorant concerning our engineering societies and concerning their varied standards for membership; and it knows absolutely nothing as to the fine distinction between a "Member" and an "Ass. Member"; between the "Fellow" of the American Society of Civil Engineers, who has been tagged with this distinction because he gave some money to the society, although he may not be an engineer at all, and the proposed "Fellow" of the Electrical Engineers, who is to be an electrical engineer of extra high voltage.

And why should the business man be profoundly impressed with the fact that John Smith, who is a candidate for an engineering position, is a Member of such a society in such and such a grade?

There are in all the societies admittedly a larger or smaller percentage of members whose professional attainments are at best mediocre. On the other hand, there are in all the branches of the pro-

fession engineers of eminence and high standing who are, for one reason or another, not connected with any of the societies. Again there are in all the societies members in the lower grades who stand head and shoulders above many men in the highest grades, in real professional ability.

Let us be sensible enough to look at this whole matter from the viewpoint of the general public. Let us realize that the public does not and connot be made to understand these fine-spun distinctions in the engineering societies.

All engineers will agree, probably, that it would be an excellent thing if the public could be brought to have some idea of the standing of the national engineering societies and of what membership in them signifies. If that end is to be attained, however, the various societies ought to follow something like uniform practice in their standards for admission to membership and in their membership gradations. The multiplying of titles is particularly to be deprecated. We have already in the national engineering societies the grades of Honorary Member, Member, Associate Member, Associate, Junior and Student, besides a score of "Fellows" in one society, who were taken in many years ago, when it was desired to honor certain generous patrons.

It may be said that there is a precedent for the establishment of the grade of "Fellow" by the Electrical Engineers inasmuch as the grade exists in numerous scientific societies and in the American Institute of Architects. The situations, however, are not parallel. If the engineer desires to stand well before the public, it must be because of his practical ability. The public does not expect practical ability in the scientist. It may indeed respect the scientist according to the number of letters of the alphabet that he writes after his name. The architect, also, the public regards as an artist, and he may indulge himself in fancy titles without loss of credit; but if the engineer wishes to be esteemed for his practical ability, he should beware of the display of titles which may have been bestowed upon him.

Under American conditions, it seems to us that the various engineering society titles and grades should be regarded like the regalia affected by some secret societies—entirely proper to be worn within the precincts of the society itself, but in very poor taste when displayed to the public.

And there are sound reasons why even among themselves, engineers should beware of multiplying gradations with respect to professional ability. With all due respect to the conscientious work done by committees of the various societies in sifting applications for membership, it is at best a crude way of rating a man's professional ability. It would not be at all a difficult matter to name in any of the societies men in the Associate or Associate Member grade who are superior in professional ability and attainment to other men who have been honored with full membership.

Again how arbitrary are some of the distinctions shown with respect to membership. Membership in the Institution of Civil Engineers of Great Britain is doubtless considered a greater honor by the profession generally than membership in any other engineering society in the world. But the necessary thing to attain membership in that organization is to have done important work in actual construction.

Certain American engineers, for example, who are universally recognized here as in the highest rank of the profession, would be unable to secure admission to the Institution of Civil Engineers because their work has been entirely in the office in designing or executive or research work, and not in the field.

Notwithstanding all that has been said concerning the desirability of fixing a high standard for full membership in the national engineering societies and careful distinction of lower grades, there are strong arguments for pursuing exactly the opposite course; that is admitting to membership any man of good reputation, engaged in any sort of engineering work, who cares to identify himself with the society. Perhaps the largest and most prosperous engineering society in the world, the Verein Deutscher Ingenieure, has only a few broad requirements for admission and numbers over 23,000 members. The Institution of Mining and Metallurgy of Great Britain, one of the most important organizations in the world in that field of engineering, also has only one grade of members.

We have recited these facts because we desire to see sound sense prevail in the conduct of the great engineering societies. The increase of their influence and reputation with the profession and with the public is so important that wise counsels ought to prevail in the establishment of membership grades. The attention of the men belonging to them ought not to be diverted by fine-spun distinctions, impossible to draw with accuracy and clearness, between members of different grades of ability.

The engineer who is a member of an engineering society ought to be and generally is a good fellow. He ought to be, to some extent at least, a wise fellow; but he will do well not to advertise himself to the public as a fellow of any sort.

A Small, Neglected Septic Tank Installation*

By F. L. Stone†

Each problem of sewage disposal has some interesting elements peculiar to its individual surroundings. Such a problem, presenting several of these elements in an inseparable combination, was referred to the writer, who called to his assistance Langdon Pearse, who is in charge of the experimental disposal plant of the Sanitary District of Chicago.

A suburban town [and county seat] in Illinois, with 3500 inhabitants, demanding civic beauty as well as utility in its public works, is located on three slopes of a circular hillside, draining to a low, flat basin which has an outlet of slight grade extending southerly and then westerly to a small branch of the DuPage River, distant about four miles.

In 1904, the late Wm. B. Ewing prepared plans for and superintended the construction of a separate system of sewers. These are of vitrified pipes, 8 to 15 in. diameter, for the sewage carriers, and 10 to 30 in. for the storm drains. The grades in the collecting systems are comparatively steep and in the mains very flat. The average distance of travel in the pipes is a little less than a mile. As the streets have been improved and the area covered by buildings increased, the main storm drain has become inadequate and will be replaced by a 6-ft. main outlet of concrete.

The sewage flow passes through a septic tank constructed under the Cameron patents, which was located at the time of construction over half a mile from residential property. The tank is divided into two equal compartments, each being approximately 9x55 ft., and 8 ft. deep, and holding 33,000 gal. The daily dry-weather flow as measured was 80,000 gal., considerably less than the usual average. When the ground is saturated the flow is about doubled by the addition of seepage.

The effluent from the septic tank discharges into an open ditch at the outlet of the storm drain. The dry-weather flow in the storm drain is about equal to the sewage flow and contains considerable laundry waste and at storm times considerable refuse from the streets. The ditch passes through golf grounds, country estates and very desirable future residence property. Its grade is very slight, falling only 2 ft. in the first 4000 ft., 4 ft. in the next 2000 ft., and then at a rate of 1 in 2000 to the outlet. Considerable nuisance was complained of and as damage suits were threatened, the authorities sought relief. The existence of the nuis-

*Abstract of a paper read at the annual meeting of the Illinois Society of Engineers and Surveyors, at the University of Illinois, Urbana, Ill., Jan. 17-19.

†Ewing & Stone, Engineers, Monadnock Block, Chicago.

ance was very evident and it was found to have the following contributing elements.

(1) The ditch was overgrown with grass and weeds, and small obstructions lodged at intervals formed pools of stagnant water.

(2) The tank had not been cleaned since its construction. Half of the compartment at the inlet end was filled with humus-like scum nearly to the bottom; in fact, one side was choked completely. The bottom of the outlet half of one compartment was filled nearly to the baffles or scum boards with heavy black septic sludge, so solid that a 7/8x3-in. board could not be pressed through by hand to the floor. An attempt to loosen the sludge and pump it out with a centrifugal pump was a failure. In the other compartment the sludge was not so dense. The heavy scum was removed, placing both compartments in operation. The tank was unloading sludge almost equal in quantity to the undigested solids flowing in.

(3) The laundry waste and the street refuse from the storm sewer lodged in the stagnant pools and decomposed rapidly.

(4) Mosquitoes found the pools and adjacent grass and weeds to be a favorable breeding place.

Pending final disposition, the grass and weeds were cut along the ditch and the obstructions to the flow removed. An unusually rainy autumn furnished relief by partial flushing, and by increasing the flow in the storm drain diluted the tank effluent. The tank has been given a thorough cleaning, which will be repeated at intervals to prevent the sludge unloading. The construction of sludge drying beds has been recommended; also the remodeling of the tank so as to facilitate cleaning, and a rearrangement of the scum boards and baffles to give a fresher effluent and prevent the gases from mixing the septic sludge with the effluent or disturbing the settling process.

Ultimately the dry-weather flow from the storm drain must be pumped to the septic tank and the effluent from the tank treated by aëration and oxidation in sprinkling filters or on sand filter beds. On account of the encroachment of residential property on the site of the present tank, it seems inadvisable to expend much money for works at this location. Sewage facilities will soon be demanded along the ditch, and it is probable that a new site will be selected some two miles farther down. Before the final details have been worked out, it may be found desirable to extend the storm drain or to provide a closed carrier for the dry-weather flow beyond the district from which the complaints now come. The situation is unique in that a fresh, strong, domestic sewage must be transformed unobtrusively into a clear, odorless liquid, equivalent to fresh spring water, without the aid of any diluting medium.

Settlement and Reinforcement of the Unity Building, Chicago

The Unity Building, Chicago, is a 16-story office building, fronting on Dearborn St. and at the corner of an alley in the block between Washington and Randolph Sts. It was built in 1892, its architect being Charles J. Warren, who designed a number of buildings in the down-town district about that time. It is about 80x120 ft. in plan (with the shorter side on Dearborn St.) and about 200 ft. high from curb to roof. It has cast-iron columns (with flanged ends) and I-beam floor framing, the wall columns being of rectangular section and the interior columns of circular section. The floors are of tile construction. The foundations are of the spread type, each column having a rectangular footing slab of concrete reinforced by layers of steel rails. These footings are about 12 ft. below the street level. The column spacing is 15 ft. 10 in. on the street side and 16 ft. on the alley side.

Settlement was noticed within a few years after completion, being mainly on the south and west sides (the alley and Dearborn St., respectively). In 1900, measurements were made with a plumb line (having a plumb-bob suspended in a bucket of water), and the building was found to lean about 6 in. to the south (the alley side). In 1910, the Illinois Tunnel Co. built one of its narrow-gage freight railway tunnels under Dearborn St., and under the alley next to the Unity Building, this company having rented the building on the south side of the alley. The tunnel had its rail level about 40 ft. below the surface, and in the alley its north wall was under the south edge of the column footings of the Unity Building. The construction of this tunnel in the clay bed underlying the city evidently increased the tendency of the building to settle along its south side, and the extent of its leaning on this side led to complaints being made to the Commissioner of Buildings as to the safety of the structure. It may be noted that very few cracks developed in spite of the settlement, owing, no doubt, to flexibility in the superstructure framing.

It is stated that while the tunnel under Dearborn St. was built by the pneumatic system, this system was not employed for the branch under the alley, so that there was greater liability of movement of the subsoil on this side.

In 1911, the Commissioner of Buildings appointed E. C. Shankland and L. E. Ritter to examine and report upon the condition of the building, and they were assisted by K. Lehmann, of the engineering bureau of the Department of Public Works. No bench marks were available for checking the settlement with the original elevations, but measurements were made of the inclination of the building from the perpendicular. These measurements were taken from the level of the 12th-story windows (136 ft. above curb line), owing to the ornamental work and cornice making it difficult to get exact points above this. In July, 1910, the inclination was found to be 15/8 in. on the south and 1 in. on the east side; and in November, 1911, this had increased to about 18/8 in. It was then estimated that the total inclination at the roof line was about 27 in.

The building was reported to be unsafe, and the city authorities then required the owners (the Unity Safe Deposit Co.) to remedy the conditions. The owners engaged E. C. Shankland, consulting engineer, to make an investigation of the condition of the building and to report upon methods for restoring its safety and stability.

The first part of the investigation was to closely examine every column joint in the building; this work being done at night, so as not to interfere with the tenants. It may be said that no structural plans were available, the architect having left Chicago several years ago, and plans filed with the city having been destroyed by fire. It was found that at nearly every joint the bearings were not uniform, while in many cases some of the bolts through the flanges had been omitted, generally where the holes did not register properly. The contact bearing at each joint was examined very carefully by means of lights, and where the surfaces were not in contact shims were inserted. Turned bolts were inserted in the open holes, the holes being reamed out to a proper fit. At the same time, every column was drilled to ascertain its thickness. For every floor a plan was made showing for each joint the missing bolts and the actual bearing surface of the columns. The lack of complete bearing surface was almost universal, and was quite irregular, so that the settlement of the building had apparently little or no influence upon this structural defect. Presumably the columns were not faced, and the castings were not sufficiently true to insure contact of any two columns around the entire circumference of the contact surfaces.

In addition to this, it was found that no diagonal bracing existed below the third floor, although this had been provided for originally, the connections being found in place. In some of the upper floors, also, the diagonal bracing originally placed had been removed, in order to accommodate certain changes in partitions and interior arrangements. It seems strange that persons ordering or executing such work should not realize the possible danger of alterations disturbing the structural framework of the building, but this is by no means an isolated case. A somewhat similar case was at the Coliseum Building, Chicago, which has roof arches springing from foundations

below the floor level. It was seriously proposed to cut out the tie rods connecting the arch shoes, in order to put in a large swimming tank. Fortunately, engineers were consulted before work was begun, or a great disaster might have occurred.

To make the frame of the Unity Building stable in itself it will be necessary to increase the diagonal bracing, partly by replacing the old work that has been removed and partly by putting in additional work. In some cases this latter will consist of diagonal rods in the plane of the walls and partitions; but where the columns are in open rooms this division of the space is not permissible. For these cases, the plan proposed is to inclose each column in a pair of steel channels, surmounted by I-beams beneath the floor, and connecting the channels and I-beams with heavy knee braces.

With the stability of the framework thus secured, there is still the problem of preventing further settlement; and this, of course, is the more serious matter of the two. The plan recommended is to support the columns on concrete piers sunk to rock by the open caisson method now so commonly employed for building foundations in Chicago. Just how many of the columns must be treated in this way has not been determined, but the present plan is to put piers under all the wall columns of the alley side, and the Dearborn St. side, and under the first row of interior columns on the alley side. As the first interior columns on the east side are close to the wall columns, the two will be combined on one support. When all these pier supports are completed it will be determined whether any additional piers are necessary.

No attempt will be made to raise or jack up the south side of the building, but the new foundations will be wedged up solidly under the present foundations so as to prevent further settlement. This arrangement is made practicable by the fact of the low side being along an alley. If it had been over adjacent property, upon which the owner desired to erect a high building, it would have been necessary either to compensate this owner for the space occupied or to have in some way removed the overhang.

The sinking of the caissons and construction of the piers can be done without any interference with the occupancy of the building. In fact such work has been done in many cases to put in foundations for a new building, while keeping the old building in use until the foundations are ready for the superstructure. It is only necessary to vacate the basement, the work being done from this floor, and material being delivered through chutes or shafts at the edge of the sidewalk.

The Unity Building is only one of many cases of settlement of this kind, as several of the older buildings in Chicago have settled more or less, largely due to the disturbance of the clay formation by deeper underground excavations for tunnels, foundations, etc. It may be remarked that the Ellsworth Building, also on Dearborn St., is inclined to the south so as to overhang a valuable corner lot; the question as to the responsibility for this condition and for remedying it is now in the courts. In designing the Marquette Building, future settlement was provided for by placing a heavy screw in the base or shoe of each column, so that any column might be jacked up to its proper level. The Board of Trade Building is a very heavy masonry structure which settled gradually for several years, but its settlement was mainly vertical. A few years ago, the load upon its tower foundations was reduced by removing a part of the tower and a heavy bell therein.

Proposed Changes in the American Institute of Mining Engineers

At the annual business meeting of the Institute to be held on Feb. 20, several amendments to the constitution are to be voted upon, which, if adopted, will effect very radical changes in the organization. It is proposed, in the first place, to change the name of the society to "the American Institute of Mining and Metallurgy." Provision is to be made for the admission of students of mining, metallurgy, chemistry or kindred sciences into a grade to be known as Junior Members. The qualifications for admission to membership are to remain practically the same as at present; that is to say, all persons engaged in mining, metallurgy or metallurgical engineering in a professional capacity or otherwise are eligible to election as members.

The most important change proposed is an increase in the membership dues to be hereafter charged. At present the annual dues are $10 per year. It is proposed to alter this so that full members (to be known as corporate members) shall pay $15 per year, and an initiation fee of $10 when elected. In addition to this, any member or associate member residing within 50 miles of the institute headquarters in New York City must pay annual dues of $5 per year additional.

These various changes have been recommended by a special committee which was appointed at the annual business meeting held in February last year, made up of Prof. Joseph W. Richards, E. G. Spilsbury and Theodore Dwight.

Widespread opposition to the proposed changes, especially the increase in dues, has already been manifested among the members of the Institute. A number of members of the Institute residing in New York City have joined in a protest against the proposed changes and have sent out a circular letter to the membership requesting proxies to be voted at the annual meeting against the proposed changes. We print the circular with the names attached as follows:

We, the undersigned, intend to vote against an increase of dues, and we ask the coöperation of members unable to attend the forthcoming meeting, who are of the same mind in this matter as we are.

The reasons for an increase of dues offered officially by the secretary of the institute are, in our opinion, vague and unsatisfactory. Without denying that an increase may be advisable, we propose to contest such a measure until full information respecting the situation has been communicated to all members of the Institute; and until after it has been determined by a careful investigation of the Institute's affairs that the same purpose cannot be accomplished by economies in administration.

We intend to offer a resolution to appoint an independent committee to study the affairs of the Institute before any further action be taken. If you desire us to vote for you upon these principles, please execute the proxy that we inclose herewith.

George C. Stone,	J. R. Finlay,
Chris. R. Corning,	J. Parke Channing,
W. R. Ingalls,	F. F. Sharpless,
J. Langeloth,	W. H. Nichols, Jr.,
Otto Sussman,	J. A. Van Mater,
Allen H. Rogers,	Arthur Thacher,
Lewis G. Chance,	Robert Peele,
H. M. Chance,	W. C. Ralston,
F. L. Garrison,	Richard H. Vail,
John H. Allen,	E. B. Kirby,

A meeting of members of the Institute who are also connected with the United States Geological Survey was held in Washington on Jan. 27. Fourteen members were present, including Messrs. George Otis Smith, E. W. Parker, W. Lindgren and A. C. Spencer. The resolutions printed below were adopted and were later concurred in by Messrs. George P. Merrill, of the National Museum, and J. A. Holmes, of the Bureau of Mines, who were unable to be present.

The members of the American Institute of Mining Engineers present do not approve of the proposed change of name of the institute to "American Institute of Mining and Metallurgy."

The members of the American Institute of Mining Engineers present are not in favor of the change in classification of members on the basis proposed in the circular, which is not a reclassification based upon professional standing.

In the absence of a financial statement showing that an increased income is necessary, the members present are opposed to the proposed increase in dues.

Cost of Road Repairs in New Jersey has nearly quadrupled in the past four years, according to the report of the Commissioner of Motor Vehicles. It is stated that in 1907, the cost of road repairs for the state amounted to $600,000. This increased to $800,000 in 1908 and in 1910 had reached over $1,500,000. The Commissioner advises that to keep the roads in passable condition in 1912, an immediate expenditure of $2,500,000 is necessary. This outlay for repairs is not merely a matter of making the roads smooth and comfortable for automobile use, but is necessary to prevent the entire destruction of the roads. The Commissioner says in his report, "If heroic measures are not taken, in two years, our great road system will be well beyond repair."

Lowering a Chicago River Tunnel*

By Wm. Artingstall†

The deepening of the Chicago river necessitated the lowering of three street railway tunnels which formed an obstruction in the deepened channel. In the Van Buren St. tunnel, a new flat roof was first built beneath the old arch roof, and later the bottom was rebuilt at a lower level, to give the necessary headway under the new roof.

*From a paper on "The Chicago River Tunnels: their History and Reconstruction," published in the November number of the "Journal of the Western Society of Engineers" (Chicago). For a general explanation of the conditions see the note appended to this article.

†Division Engineer, Board of Supervising Engineers, Borland Block, Chicago.

The Van Buren St. tunnel as originally built had a three-centered brick arch, 30 ft. span at the springing line, and 20 ft. in height from the invert to the crown (Fig. 1). The east and west approaches are respectively 142 ft. and 303 ft., while the tunnel proper is 1052 ft., making a total length of 1517 ft. from end to end of approaches. The brickwork was all laid in Utica cement mortar except the two outer courses, which were laid in asphalt. On top of and surrounding the brickwork was a course of concrete, varying in thickness from 2 to 3 ft. The floor of the tunnel was an inverted arch, 2 ft. thick at the center and about 3 ft. at the sides. A Bedford stone skewback separated the arch and invert.

The New Roof

The new roof was built only in the river section, and consists of 32-in. steel girders 32 ft. long, with concrete jack-

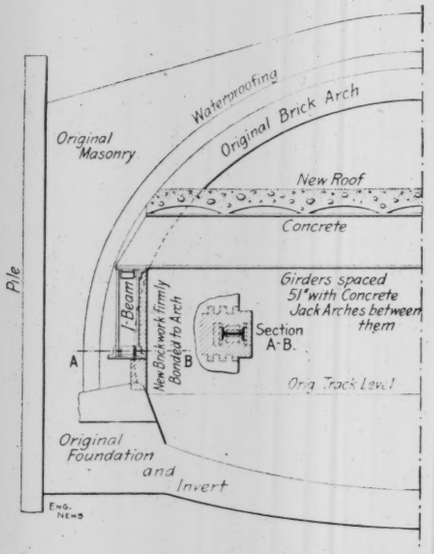

FIG. 1. HALF-SECTION OF RIVER PORTION OF THE VAN BUREN ST. TUNNEL, CHICAGO, SHOWING THE OLD ARCH ROOF AND NEW FLAT ROOF

arches between them. These girders rest on 15-in., 80-lb., I-beam columns 4 ft. 3 in. centers, set in chases cut in the brick arch. Over the entire roof and extending up into the bulkheads, was laid a waterproof course of brick imbedded in and flushed with a hot asphalt compound. This is protected by a 12-in. course of concrete. As the new roof was to be completed before lowering the invert, chases for the I-beam columns were first cut in the sides of the existing arch. The buckle plates were abandoned; [these were originally planned to be riveted to the top flanges of the girders forming a steel diaphragm between the jack arches and the outer covering of concrete.] The columns were concreted in place by Dec. 1, 1906. The tunnel portals were then barricaded for winter and forms erected for jack arches between the girders. All the material for concrete was delivered into the tunnel on wagons and stored near the west end of the new roof. As the temperature in the tunnel never fell below 50° the concreting continued day and night until completed on Jan. 12, 1907.

All the concrete was mixed by hand on platforms placed beneath the new roof, loaded into box barrows and hoisted by means of a hand winch to the top of the new roof. In dumping the first few batches of concrete in each arch, considerable difficulty was experienced in keeping the stone from "rattling" away from the mortar and collecting along the lower flanges of the girders. To remedy this about 4 in. of mortar was first spread along the flange and then worked into the loose stone. The result was all that could be desired. The concrete was mixed wet and thoroughly puddled while being placed.

Two shifts were employed on the work and in almost every case work continued until the concrete between any two girders was all placed. A 3-in. course of concrete was then spread over the entire roof. This was allowed to set and thoroughly dry for two weeks before starting the waterproof course. Meanwhile the brick arch over each girder was cut away for a width and height of about 2 ft., clear back to the old waterproofing. These openings were then cleaned out and slushed with pure asphalt at a temperature of about 350° F. Hard sewer-bricks were then imbedded therein and flooded with the same asphalt mixture.

The specified waterproofing was one course of brick and a mixture of asphalt and gypsum, but so much trouble was encountered by foaming that this mixture had to be abandoned and a mixture of asphalt, asphaltic cement, and marble dust substituted. This retained the heat longer, gave no trouble in the boiling pan and adhered better to the bricks. But, like the other, the new mixture would not adhere to concrete. To remedy this feature, a second course of brick with 1½-in. joints was imbedded in the filler course of asphalt, and the upper part of the joints filled with cement grout.

During the construction of the bulkheads [closing the space between the old and new roof at each end of the river tunnel], the old arch was systematically cut away over each girder for a distance of 2 ft. longitudinally and the same in height. These openings were then blocked with oak wedges which left intermediate spaces of about 2 ft. width that were afterwards partially cut away and blocked up. All the material cut out was

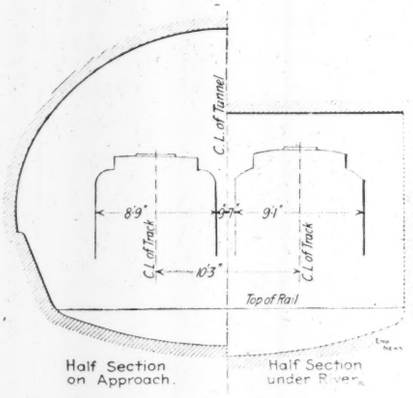

FIG. 2. CROSS-SECTIONS OF RECONSTRUCTED TUNNEL

piled on the new roof to form a cushion, and to this was added all possible debris and filling from the tunnel.

Lowering the Invert

The removal of the tracks, cable yokes and roadbed exposed the full length of invert to be lowered. A concrete mixing platform was built near the west portal and a double narrow-gage track was laid from this to the dumping platform at the east end of the tunnel. The mixing platform was about 8 ft. ft. above the track level, so the concrete was spouted directly from the mixer to the

cars. These were lowered down the incline by means of an electric hoist located directly beneath the mixture. The cement, sand and stone were teamed down a planked roadway to the mixer.

At the center of the dumping platform, which was about 8 ft. above the sidewalk (at Franklin St.), an electric hoist was located with a track on either side. These tracks accommodated two cars of excavation or just a wagon load. As soon as one car was dumped, the wagon was moved under the other car and the first car was lowered into the tunnel. The cable was then hooked into a loaded car which would be raised to the dump and was in position by the time another wagon was in place. The second car was then sent below and the operation repeated.

All the hauling was done in the morning, and as many as 160 cu.yd. of excavation were taken out in five hours. This, however, was an exception, for almost every day the lack of teams caused delays. The excavated material would then have to be deposited along the sides of the tunnel and afterwards hauled out.

In starting this work the entire length of the tunnel was marked off in 5-ft. sections with five sections to a series. Excavating was then begun on Sec. 1 of Series A, then on Sec. 1 of Series B, and so on to Sec. 1 of Series G. As it usually took at least a week to finish a section in each of the seven series, we could then go back and start on Sec. 2 of Series A, knowing that the new concrete had a good seven days' set before the underpinning on the adjoining section was started. This system was followed throughout the entire lowering of the tunnels. [Fig. 2 shows sections of the river tunnel (as altered) and the approach, the latter having the old arch roof but the floor lowered to the new grade.]

The underpinning [of the side walls] was carried on simultaneously with the lowering of the invert. No difficulties were encountered other than those to be expected in an undertaking of this character where it is not known what is ahead or beside the work, and where the existing work was not planned with a view of putting it on stilts. The main difficulty, however, was from places where the foundations were poor, at which places, unfortunately, water was always encountered, and also old piles from the cofferdam used in the construction of the tunnel. These piles were encountered in almost every section, sometimes within a few inches of the inside face of the tunnel and at other times farther back under the walls.

A testing needle was used in every case and almost invariably showed that these piles were the outside limit of the walls, beyond which we could not go. In case the needle encountered something hard beyond the pile, we carefully followed back along the concrete and in some cases managed to get an extra foot of thickness for the foundation. Too often, however, we were disappointed and the new foundations had to be reinforced. For this reason the face of the foundations was moved 9 in. into the tunnel in order to obtain the requisite width at the base.

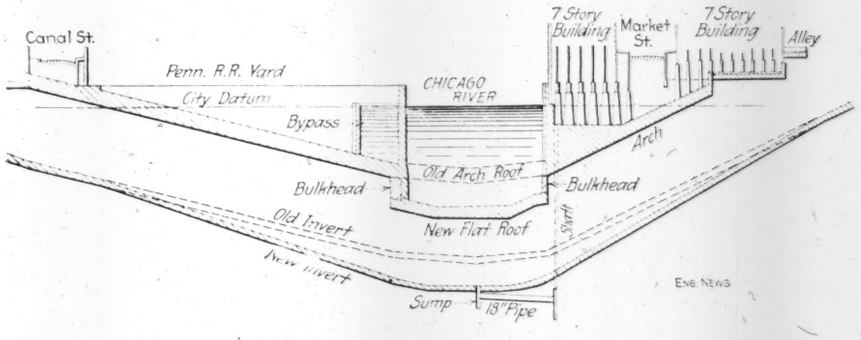

FIG. 3. LONGITUDINAL SECTION OF VAN BUREN ST. TUNNEL, SHOWING THE OLD AND NEW ROOF AND INVERT; ALSO THE DRAINAGE SHAFT AND THE HEAVY BUILDING SUPPORTED ON THE ROOF ARCH OF THE EAST APPROACH

The excavation varied in depth from 2 to 12 ft., and the material varied from soft blue clay to hard-pan. A number of pockets or rather lenses of white sand were encountered, which was as fine as flour and flowed like water. One of these lenses was about 15 ft. wide, 2 ft. thick, and extended clear across the tunnel and under the walls.

DRAINAGE

The new drainage system consists of a pump well located in the north wall just east of the new roof and two sumps, one directly opposite the pump well and the other approximately in the center of the river section. The west approach to the tunnel is drained by a 12-in. vitrified pipe laid along the invert to a catch basin at the middle sump, and thence through an 18-in. pipe laid under the invert at a 1% slope to the sump opposite and connected with the pump well by an 18-in. pipe. The east approach is drained by a 12-in. pipe laid along the invert and emptying into the sump opposite the pump well.

The track level at the pump well is about 22 ft. above the drain from the center sump. As this made nearly a 30-ft. suction on the pump, it was necessary to build a pump chamber below the track level. This was a dangerous operation on account of having to underpin the walls on either side of the old pump well which had a 6-ft. by 5-ft. opening, was 9 ft. high, and had a 5-ft. shaft leading to the boiler room of the building above the tunnel. Directly over this section are the columns carrying the floors of a double seven-story building (Fig. 3). The footings of the columns are carried by the tunnel arch. This brought approximately 30 tons per lin.ft. on the foundation at this point. The corners of the old pump chamber had been eroded by water and ice until the opening was increased 2 ft. beyond its original width, thus concentrating the load on a small bearing area and necessitating the greatest care and caution in prosecuting this section of the work.

The poor brickwork was carefully cut away, the corners squared, and a solid wall of vitrified brick built across the face of the former pump chamber. Two I-beams were built in this wall, and an eye-bolt, for raising and lowering the pumps, was projected through the small arch which forms the base of the wall. It was then the intention to underpin the corners of the pump chamber, but shortly after starting a bed of fine sand was found which seemed to pass directly under the east corner of the chamber. This sand, though absolutely dry, flowed like water, and, not caring to undermine the wall, we changed the procedure and gradually underpinned the wall to the east and west, thus working toward the pump chamber a few feet at a time.

When within 2 ft. of the corners, we cut away the face of the old pump well and underpinned the remainder by "legging" down 5 ft. at a time until the bottom of the chamber was reached. The floor was then put in and the first 8 ft. of the pump well excavated.

Bricklaying had just begun when water flowing down the shaft drowned out the bricklayer and began caving in the sides of the well. This was hastily sheeted up and braced and provisions made to build a concrete well. When everything was ready, the water was pumped out, the well cleaned up, and the sheeting removed. A drum was then lowered to place and concrete quickly dumped around it. The drum was allowed to remain in place for three days, when it was knocked apart and the re-

mainder of the well sunk without any difficulty. We afterwards had a grout machine brought down to the tunnel and pumped 65 bags of cement behind the wall of the old shaft. This has effectively stopped the leakage and the shaft is now practically dry.

Removing the Old Roof Arch

On Jan. 13, 1908, the contractors started to remove the old roof. They had not proceeded far, however, when so much water began to come through the old concrete beneath the stone wheelguard that it seemed expedient to stop the dredge until the concrete could be repaired. The old concrete was then cut away for a depth of 8 to 12 in., and in places as much as 2 ft. Several deep holes were found which seemed to have a direct connection with each other back of the solid concrete. A one-inch bleeder was put in each of these and projected out through the forms which were erected along the length of the old work. The old concrete was then replaced by a mixture of one part cement, two parts sand, and one part very fine gravel. This was mixed quite wet and thoroughly puddled. The bleeders were left open, and although for a time they flowed full, no water has come through the concrete.

On. Feb. 10, 1908, the new pump was installed in the pump chamber and on the same day, the contractors started to drill the old roof before putting the dredge to work. The drilling was done by a drill boat. The holes were drilled about six to ten inches apart and about two or three feet longtitudinally. Near the dock lines the holes were drilled as closely together as possible. Considerable water leaked into the tunnel shortly after the drilling started, but the number of leaks and quantity of water continually decreased as the drilling progressed.

After the old roof was removed, a blanket of clay was spread over the tunnel, and as this settled into place the leakage still further decreased. The few leaks which remained were choked up by first cleaning out the hole and inserting a thin lead pipe about 4 in. long. This was held in place by a mastic of clay and cement and the adjacent surface carefully plastered a little at a time until the pipe carried all the leakage at that section. Two or three days elapsed before the pipe was plugged with oakum and cement and clinched. Sometimes the water would break out in a fresh place, but by repeating the operations, as above, and allowing the pipe to remain open a few days longer, we succeeded in stopping practically all leaks in the new work. Those that could not be stopped up have been piped and the water is carried down the walls in pipes to the drain under the track.

The Great Lakes Dredge & Dock Co., had the contract for this work and the superintendent in immediate charge was Mr. Thos. Osborn.

[The lowering and reconstruction of three tunnels under the Chicago River has afforded interesting examples of engineering work done under exceptional difficulties and requiring ingenuity and skill in devising methods and executing the work. The Van Buren St. tunnel, as built,* differed from the others in having a double-track arch instead of twin single-track arches for the river portion. The methods of lowering were different from those employed in the other two cases. The reconstruction of the roof was described in our issue of March 17, 1907, but at that time the lowering of the floor had not been undertaken. We have given above, therefore, a description of the reconstruction of this tunnel taken from a paper written by the engineer who was in direct charge of all the tunnel work for the Board of Supervising Engineers. This Board has general oversight of street railway affairs and improvement, and is composed of representatives of the city and the companies. The general conditions of altering the tunnels, with particulars of the original construction, were reviewed in our issue of Sept. 13, 1906. The reconstruction of the Washington St. tunnel was described in our issue of July 21, 1910. The work on the LaSalle St. tunnel was described in our issues of Jan. 12, April 13, Aug. 10 and Sept. 21 1911.—Editor.]

The Recovery of Waste Metals in 1910 has recently been reported by the U. S. Geological Survey. The figures of the accompanying table show the recovery of secondary (This term is used to distinguish from "primary" metals won from ore.) metals from scrap, sweepings, drosses, etc. There was an increase over 1909 occasioned partly by increased business activities, and a tendency toward greater conservation of wastes, and also in part by the fact that during this year the Survey made a more extensive canvass of the sources of secondary production.

*Engineering News: 1890, I, 170; 1894, I, 294, 335.

Timber Lattice Truss for Roofs

An interesting type of timber roof construction is being used somewhat extensively in the Middle West, more especially for automobile garages and the smaller class of shop or industrial buildings. It consists in the use of timber lattice-web trusses, the truss having a horizontal bottom chord, parabolic top chord and latticed web system. Among the advantages claimed are strength, durability, good appearance, low cost and the absence of intermediate supports. It is stated also that in some cases this roof construction has been specified for the special reason that it is not affected by acids or acid fumes. It is said to be 25% cheaper than a flat roof, and 50 and 75% cheaper than an ordinary wood truss and a steel truss roof respectively.

The general design is shown in Figs. 1 and 2, showing a truss of 50-ft. span designed for 25 lb. live load and 20 lb. dead load per sq.ft. of roof area, with trusses spaced 16 ft. apart. The top chord is given the approximate form of a parabolic curve, for the reason that with a uniformly distributed load the compression and tension in the upper and lower chord are practically equal. The rise is about one-eighth of the span. Each chord is composed of two parallel members with the ends of the web members or lattices sandwiched between them and secured by through bolts. The web members are also spiked together at each intersection; and at the ends of the truss these members are placed close together, forming a solid web to take the shear. Where the depth of the upper chord is such that it cannot be easily bent to the required curve in one piece, it is built up of smaller pieces, as shown by the section in Fig. 2. The ends of the top chord are held by wrought-iron straps, except that in the larger trusses they are fitted to angle-iron shoes held by two side rods attached to an anchor passing horizontally through the bottom chord. In the 50-ft. truss shown in the cuts, the strap is $\frac{7}{16}$x5 in., and 3 ft. long; it is secured by eight $\frac{7}{8}$-in. bolts with 5-in. spacing.

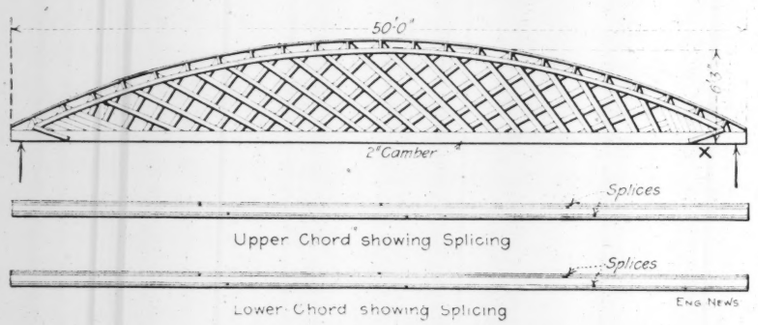

Fig. 1. Timber Lattice Truss for Roof of 50-ft. Span
McKeown Brothers, Chicago, Builders.

In most cases, 2-in. lumber is used in the chords, and the parts are thoroughly nailed together with 10d. to 60d. nails (or bolted in the larger sizes). The ordinary trusses are built for spans up to 100 ft., and are designed to carry a safe live load of 25 lb. per sq.ft. of roof

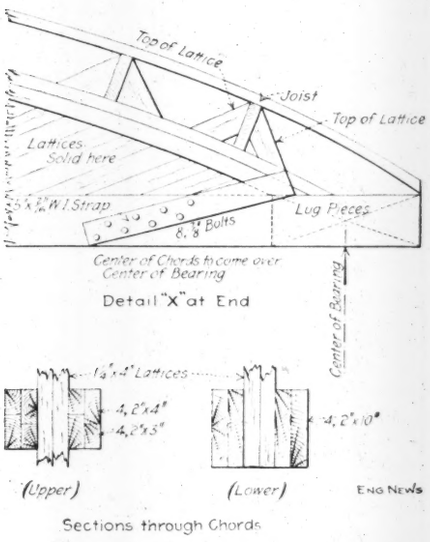

FIG. 2. DETAILS OF CHORDS AND ENDS OF TIMBER LATTICE TRUSS

area, in addition to the dead load of roof (or roof and ceiling). Special trusses can be designed where greater strength is required. The trusses are built on the ground at the site and placed in position by a derrick or gin pole. The upper chord is bent to the proper curve by special tools and a slight camber is given to the lower chord (2-in. camber in 50-ft. spans). The material is yellow pine for the chords and Norway pine for the lattice members. The compressive stress of yellow pine is taken usually at 1000 to 1200 lb. per sq.in. In the 50-ft. span shown, the sizes are as follows: lower chord, 4 pieces, 2x10 in.; upper chord, 4 pieces, 2x4 in., and 4 pieces, 2x3 in.; lattice members, 1¼x4 in. A line of diagonal wind bracing is placed between the trusses at the middle of the span. For 75-ft. and 100-ft. trusses there are two and three lines of bracing respectively.

In some cases, the trusses are not supported on the side walls of the building, but upon intermediate posts. In such cases, knee braces are secured to the posts and bottom chords. This is shown in Fig. 3, which represents a part of the O. F. Jordan Co. car shop, at Indiana Harbor, Ind.; this shop is 75x150 ft. The trusses are of 50-ft. span, and the two side spans of 12 ft. 6 in., are covered by flat roofs.

The trusses are spaced usually 12 to 14 ft. apart, and carry roof joists 2x8 in.; for 16-ft. spacing, the joists are 2x10 in. and the trusses are made correspondingly heavier. The joists are nailed to the upper chord and fit snugly into the spaces between the projecting ends of the web members. They may be headed on alternate trusses. The standard sheathing is 4 in. dressed and matched flooring; this is bent to fit the curve of the trusses, and as it is well nailed to the joists it serves to stiffen the roof. This may be covered with asphalt or rubber roofing nailed in place, or by tar and gravel roofing on felt well mopped with a pitch composition. Skylights are put in as required.

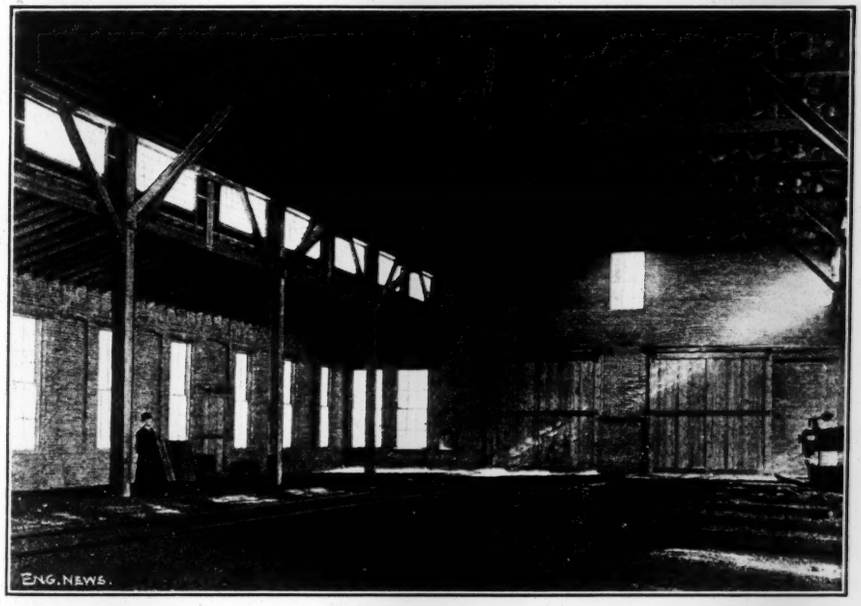

FIG. 3. TIMBER LATTICE ROOF TRUSSES OF 50-FT. SPAN SUPPORTED ON POSTS (WITH 12½-FT. SIDE SPANS)

We are informed that nearly 300 roofs of this kind have been erected on buildings of different classes, with the approval of a number of engineers and architects, as well as of building departments which have passed upon the plans. These buildings include shop and factory buildings, storehouses, schools, small theaters, assembly halls and a very large number of garages. They are located in Chicago, Milwaukee, Kansas City, Grand Rapids, Gary and other cities. They are used for shop or industrial buildings by the Illinois Brick Co., at Evanston, Ill. (125x128 ft.); the Midland Terra-Cotta Co., Cicero, Ill. (76x245 ft.); the Sheffield Car & Equipment Co., Kansas City (72x96 ft.), etc.

This roof construction is made a specialty by McKeown Brothers, general contractors, 4817 Cottage Grove Ave., Chicago. We are indebted to this firm for drawings and information, which we have supplemented from other sources.

A Civic Center for Augusta, Ga., is proposed. A central parked strip, a block or two in length, will be laid out directly in front of the center and at right angles to the Union passenger station. On either side of this there will be tree-lined driveways. Beyond one of the driveways will be the proposed new Post Office, and in the other direction, beyond the other driveway, it is expected that a Carnegie Library will be built. A half-tone view of the proposed civic center is published in "The Augustan" for November, 1911 (published by the Chamber of Commerce, Augusta, Ga.). Credit for the general scheme is given to R. Roy Goodwin, managing director of the Chamber of Commerce. G. L. Preacher is architect and B. J. Berckmans Co. is landscape designer for the project.

The Diamond on the Cross is the Bryanesque appellation which has been given to four new diagonal streets proposed for Newark, N. J., by Morris R. Sherrerd, chief engineer of the Board of Public Works of that city. The cross is formed by an intersection of Broad and Market Sts. The usual way of adding diagonal streets to a city plan is to make them radiate from a common center, but at Newark this would lead to the very condition that should be avoided: the concentration of traffic at the intersection of Broad and Market Sts., which is now almost intolerable—largely because of heavy street-car traffic. Bearing in mind that Broad St. runs north and south and Market St. east and west, the general scheme may be made plain by stating that the southerly corner of the diamond would be at the City Hall, on Broad St., from which a wide street or boulevard would be cut northwesterly to the County Court House and southwesterly to or near the Pennsylvania R.R. Station. The other two diagonal streets would extend northeasterly from the Court House and northwesterly from the Station to an intersection at Broad St., at Military Park, close by the Newark terminal of the McAdoo tunnel extension from New York and Jersey City, and a few blocks south from the Public Library. It should be added that a City Plan Commission (headed by David Grotta) was recently created, under a general legislative act to study needed improvements in the city plan of Newark.

Stairs and Other Provisions for Safe Egress from Buildings in Fire or Panic; an Expert Recommendation

The last Legislature of the State of New York appointed a committee to investigate the safety of factories, with State Senator R. F. Wagner as chairman. Among other testimony, this committee (now in session) secured the expert opinion of R. P. Miller, Superintendent of Buildings, Borough of Manhattan, New York City, who in former years was for a long time chief engineer of the bureau.

The committee early determined that the provisions of the existing New York Code in the matter of stairs (width and number of staircases), and generally in the matter of protection of egress from buildings, are entirely inadequate when applied to buildings of more than three or four stories. In the last ten years or more, a great number of buildings from eight to sixteen or twenty stories in height have been erected in the Borough of Manhattan for use as sales lofts, clothing factories and the like. These uses are of a kind to collect large numbers of people in such buildings, besides creating a very distinct fire risk. The holocaust in the burning of the shirtwaist factory of Harris & Blanck, a year ago, gave a forcible illustration of the conditions thus created. By some persons, these conditions have been attributed to lax or wrong interpretation of the Building Code by the officials charged with its administration, but it has been fully demonstrated that the administration has been generally very good, and that the fault lies in the Code itself. Recognizing this, the Bureau of Buildings has been able to secure in many cases better results than the Code strictly required.

Mr. Miller's opinions are based not only on long familiarity with the New York Building Code and with the various attempts to revise it since 1907, but also on a fuller study of the subject, which was forced upon him by the extensive criticism of the bureau after the Harris & Blanck fire. What he now proposes in his brief submitted to the legislative committee is a radical revision of the clauses relating to stairs and other means of fire escape.

Somewhat more radical provisions have been put forward by others in the past, but in no case has full knowledge of the condition and a conservative view of the possibilities of the administration of the building law in a city such as New York guided the preparation of the recommendation. For this reason, Mr. Miller's recommendations are to be considered of high value.

In his brief, Mr. Miller supports these recommendations with extensive arguments, which unfortunately we cannot take space to reproduce. We believe it desirable, however, to give the recommendations themselves, omitting the arguments and explanations:

No door, stair or passageway shall be less than 3 ft. 4 in. wide in the clear.

At least two separate staircases, with the necessary doors and passageways, shall be provided for any building over three stories in height or over 3000 sq.ft. in area.

When more than one is required, the stairs shall be so placed that at least one is always accessible to the occupants in case any one of the others is rendered impassable for some reason, and that it will not be necessary to travel more than 80 ft. in a direct horizontal line to reach either one of any two.

Every stairs shall be inclosed in an approved fireproof construction and shall have a direct exterior outlet to the street or to a court leading to a street, at the ground floor.

The risers and treads of stairs shall be so proportioned that the stairs furnish a safe and comfortable line of travel. The risers shall not exceed 7½ in. in height, and the treads shall be not less than 9½ in. wide, except that winding treads having a minimum width of 6 in. at one end and an average width not exceeding 9½ in. may be used where straight runs are impracticable or undesirable. All treads other than winding treads and risers shall be of uniform dimensions in any one flight.

No flight of stairs shall have a vertical rise of more than 12 ft. between floors or intermediate platforms; and in straight runs platforms shall be spaced equidistant between upper and lower limits.

The aggregate clear width of doors and passageways intended to serve as exits from any building or part of a building shall be at least 12 in. for every 20 persons to be accommodated, provided none is less than 40 in. wide.

The aggregate clear width of stairs and stair halls shall be such that the stairs in any story of a building may accommodate at one time the total number of persons ordinarily occupying or permitted to occupy any one floor above the flight of stairs under consideration, on the basis that at least 20 in. of width and 1½ treads are required per person.

When the building is of thoroughly fireproof construction, with no communication from floor to floor except by elevators in solid fireproof inclosures and stairs in fire towers constructed as herein elsewhere described, and all openings to the outer air are protected by metal and wire-glass windows or doors of approved construction, a reduction of 20% in the aggregate width of stairs specified may be made.

When an approved equipment of automatic sprinklers is installed in any building, a reduction of 25% in the aggregate width of stairs specified may be made.

When fire walls, of such strength and construction as to resist fire for at least 30 min., equipped with adequate openings protected by approved automatic fire-doors, are provided, a reduction of 33⅓% in the aggregate width of stairs specified may be made.

APPENDIX—SPECIFICATION FOR FIRE TOWERS

Fire towers shall have their walls constructed of brick not less than 8 in. thick, or reinforced concrete not less than 6 in. thick. Such towers shall have no direct connection with the interior of the building, but access thereto from the building shall be had on every floor through outside balconies or through fireproof vestibules, such vestibules opening on a court not less than 24 sq.ft. in area. Such outside connecting balconies and vestibules shall be at least as wide as the requisite exit width which they serve, but in no case less than 40 in. wide clear of all obstructions and shall be built of noncombustible materials and shall have solid floors and substantial rails. Such balconies or vestibules shall be level with the floors and the platforms of stairs they serve. Where vestibules are used to connect to smokeproof stair towers there shall be self-closing fireproof doors separating such vestibules both from the building and from the stairs.

Annual Meeting of the Ohio Engineering Society

The 33rd annual meeting was held at the Hollenden Hotel in Cleveland, Jan. 24-26, 1912. At the opening session the members were welcomed to Cleveland by Hon. C. W. Stage, Director of Public Safety of Cleveland. President H. K. Lindsey, of Columbus, delivered the annual address. A. J. Norton, as chairman of the Committee on Legislation, reported concerning the bill introduced in the last General Assembly, providing for the registration and examination of civil and mining engineers and surveyors. The bill was reported favorably by the committees to which it was referred in the legislature, but was repeatedly set back on the calendar and died there on adjournment of the Assembly. Mr. Norton was very pessimistic in his remarks in regard to the chance of passage of the bill, but advocated renewed efforts.

Hon. Jesse Taylor, secretary of the Ohio Good Roads Federation, said that a constitutional amendment is to be proposed in the present Ohio constitutional convention to permit state aid for road construction and another to remove the present limit on county bonded debts for roads.

In the evening, a joint meeting was held with the Cleveland Engineering Society. Mr. Goldbeck, testing engineer, U. S. Office of Public Roads, discussed the results of tests of concrete for shrinkage and contraction. He finds the shrinkage due to withdrawal of moisture much more important than temperature contraction. In 1:2:6 concrete the coefficient of shrinkage in setting is 0.00068, equal to ¾ in. per 100 ft., while the coefficient for contraction by change of temperature is 0.000005. Hence, 121° degrees of temperature is necessary to cause the same contraction as results from the loss of moisture. The coefficient is higher in case of richer mixtures. Reinforced concrete has a coefficient of 0.0003.

Concrete immersed after having been allowed to set dry will expand. This creates a tendency to shear between the top and bottom course in concrete pavements, and much failure of top dressing in sidewalks is probably due to this

cause. Mr. Goldbeck raised the question whether steel may not be materially affected by fatigue due to repeated strains caused by alternate wetting and drying of the concrete.

R. C. Beardsley read a paper on "The Design and Construction of Dams, with Special Reference to Recent Failures," illustrated with lantern slides.

On Jan. 25, Virgil C. Marani, City Building Inspector, Cleveland, discussed the work of the building-inspection department and the state and city building codes. He said the plumbing regulations in the state code were inserted in the interest of the journeymen plumbers. The Cleveland code cost $32,000 and contains 1100 building regulations, many of which are ambiguous and contradictory. For example, all school houses must be fireproof, but a later clause provides that any building less than 60 ft. in height may have a wooden roof. The force employed by the city is insufficient; 3600 elevators must be tested annually and inspected twice a year by two men. One inspector is provided for gas piping for the entire city. Recently a fee system has been adopted on the basis of 10c. per 100 sq.ft. of floor space which will approximate $1 fee for each $1000 cost of construction in ordinary buildings. By this measure it has been made possible to employ more inspectors.

E. G. Bradbury, of Columbus, read a paper entitled, "Leakage from Cast Iron Water Pipes," containing a considerable amount of statistical matter gathered from various sources and showing leakages varying from practically nothing up to over 200,000 gal. per mile daily. The Washington reports were quoted to show that about 25% of the total underground leakage thus far discovered in that city was attributable to joint leakage. A small system at Grandview Heights, Ohio, installed by the writer during the past year, was described, in which by open-trench inspection and extreme care (made necessary by the fact that the village purchased water by meter measurement at $1.20 per 1000 cu.ft.), the leakage has been kept down to practically nothing, as shown by actual test. The total consumption in the village averages 17½ gal. per consumer daily. The speaker advocated a test of this nature rather than a specified permissible leakage.

The annual election of officers resulted as follows: President, John Laylin, Norwalk; Vice-President, L. A. Fauver, Lorain; Secretary-Treasurer, C. J. Knisely, New Philadelphia; Board of Trustees, T. L. Gibson, Elyria; C. L. Bushey, Shelby; C. J. Peters, Tiffin; A. F. Cole, Marietta; M. P. Lauer, Cleveland.

At the evening session, Dr. C. S. Howe, president of the Case School of Applied Science, talked on "Some of the Needs of a Great City." Every city, in the judgment of Dr. Howe, should have a general plan of streets, parks, sewers, waterworks, etc., according to which all new work could be carried on.

In Dr. Howe's opinion, sewage disposal should be along the lines of returning to the land the elements contained, and no other method can be called scientific. He mentioned the transportation problem and stated that many failures are due to lack of proper public supervision. Good service, together with proper returns on the investment of the owners, can be accomplished only under public control.

The United States has a better school system than any other nation, but there is a lack of trade schools; 85% of all pupils do not finish the grammar grades and are ill-prepared to do effective work. In England, according to a Royal commission appointed to investigate the subject, there are 973,000 paupers, and this condition is due to the lack of training along business and mechanical lines.

Prof R. H. Fernald, of Case School, described the "Work of the Bureau of Mines in Relation to Gas Production and Internal Combustion Engines." Curves of coal consumption were shown, indicating that at the present rate of increasing consumption, our coal supply will be exhausted in about 200 years. The experimental work quoted indicated that great saving of coal, especially of the high grades, is possible by the use of producer gas; with the best West Virginia coal 2.7 times as much coal per horsepower was required by steam plants as by the producer. This result extends even to the bone coal and washer waste ordinarily thrown away. The same result was found with lignite, in which the high percentage of moisture is an advantage in the production of gas.

Professor Fernald showed with the aid of lantern slides the manner of digging and treating peat in Europe. This material contains about 80% moisture and is macerated and dried to about 20% before using. The weight of peat required per horsepower is about the same as of the high-grade West Virginia coal per horsepower in the steam engine.

At the session on Jan. 26, E. W. Groves, city engineer, Ann Arbor, Mich., described a type of pavement now being used in that city. The pavement consists of 5 or 6 in. of concrete with a dressing from ⅛ in. to ¼ in. in thickness composed of torpedo gravel and distilled tar; 2000 sq.yd. was laid in 1909, and there is now 85,000 sq.yd. in use in the city. The pavement is known as the "Dolarway," the estimated cost being about $1 per sq.yd. complete, exclusive of grading. The top dressing cost about 8 to 10c. per sq.yd. Mr. Groves used one sack of cement per sq.yd., the aggregate being local gravel. The pavement is giving excellent satisfaction.

A resolution was passed favoring state aid in the construction and maintenance of main roads.

S. W. Emerson, of Cleveland, discussed reinforced-concrete buildings.

In 100 tests of floors quoted by Mr. Emerson, there was no failure to carry from two to four times the designed load. Sudden collapses of concrete buildings have invariably occurred during construction or immediately after completion and were attributed by Mr. Emerson to overloading green concrete, removing forms too quickly or poor concrete. He states that in only four instances have reinforced-concrete buildings failed after completion and in these cases there has been warning of the failure by sagging and cracking. In two of these four cases, the building has been badly overloaded. The first reinforced-concrete building in Cleveland is about nine years old; the material was used in 83 buildings in the city in 1911. During the last year over two-thirds of the contractors who had undertaken reinforced-concrete work have given it up owing to the heavy overhead expense.

Frank R. Lander, county engineer, Cleveland, described the proposed high-level bridge across the Cuyahoga River at Cleveland. This bridge will be 2800 ft. long, including approaches. The central span is a steel arch 576 ft. long, and the lower of the two decks will clear the river 93 ft. at high water. The approaches are of concrete-arch construction. The upper deck will be devoted to vehicle and foot traffic and will have a roadway 44 ft. in width and two sidewalks of 14 ft. each. On the lower deck will be room for six street-car tracks. The gradient of the approaches is 3%. The footings of the main piers are 60 ft. x 107 ft. Rock is at a depth of 150 ft. and the piers will rest on a solid layer of clay from 40 to 90 ft. below the surface. No false work will be permissible in erecting the steel arch, as the river must not be obstructed.

Apparently all obstacles to the construction of the bridge have been removed except that the car-dumping plant of the Erie Railroad is interfered with. As soon as this matter is adjusted, the work will probably proceed.

A Campaign against Mosquitoes is proposed by the board of health, of Montclair, N. J. An appropriation of $2000 to conduct the work during the summer of 1912 has been requested of and granted by the town council. The plan as thus far outlined is to employ a sufficient number of inspectors to cover the whole town in detail for the purpose of detecting and eliminating all breeding places. During the unusually dry summer of 1911, when it would normally be expected that mosquitoes would be few, they were unusually prevalent. This was attributed in part to the fact that the low water in the numerous brooks flowing through the town resulted in many scores of stagnant pools in which mosquitoes bred freely until they were discovered and breeding stopped.

Summary of Preliminary Report on Sewage Disposal at Cleveland, Ohio*

By R. Winthrop Pratt†

(1) The intercepting sewer system planned in 1895 has been about half completed as regards the population served, and more than half completed as regards the expense involved; that is, $2,528,574 has been expended to date, and the estimated cost of the sewers necessary to complete the system is $1,861,960.

(2) The Cuyahoga River is now badly polluted with city sewage, as well as with manufacturing wastes. This pollution will be largely removed when the intercepting sewer system is completed, and then the city can insist upon purification, at individual plants, of those manufacturing wastes which may continue to enter the river direct.

(3) There is definite evidence that the discharge of untreated sewage in the lake at the main outfall has proved objectionable from the standpoint of pollution of bathing beaches; and there is some evidence that such discharge of sewage may under present conditions contaminate the city-water supply, at the intake crib.

(4) Sewage-purification works, adequate to protect the water supply from contamination from the main sewer outfall, would cost much more than works designed to simply clarify the sewage and to protect the bathing beaches. Sewage works even though producing a highly purified effluent, would not prevent possible pollution of the water supply from objectionable surface drainage entering the river and its tributaries within the city limits. Neither would such works protect the water supply from the diluted sewage which must pass into the lake once or twice a month through some thirty storm-water overflows in the sewer system.

(5) Any plan for sewage-purification works which may be adopted should provide for purifying 100,000,000 gal. of sewage per day, representing the quantity produced by 1,000,000 people.

(6) The city's sewage may be treated by one plant located near the southeasterly city limits; or, by two plants, each receiving about one-half the output of the city, one at the above location, and the other in the Cuyahoga River Valley south of the city. The additional cost for sewers and for disposal works, if one-half the sewage is thus diverted toward the south, would not be great; and if it should be decided that filters were necessary in the northeasterly installation, then there would be a distinct saving by constructing the southerly plant.

(7) The cost of construction of the suggested sewage-treatment plants, on the basis of 1,000,000 people, eliminating untried methods, varies roughly from $1,100,000 to $7,700,000, according to the type of plant and degree of purification sought. The estimated yearly expenditure, including interest charges, varies roughly from $140,000 to $750,000.

(8) The probable minimum difference in annual cost, including interest charges, between a low-efficiency sewage plant (to be used in case water-purification works are installed), and a high-efficiency sewage plant (to be used in the absence of water-purification works), is $104,000; this difference may be increased if it is shown by the detailed tests, recommended further on, that larger quantities of bleaching powder than those herewith estimated are necessary to effect satisfactory purification. The difference in annual cost between tank treatment alone and tank treatment together with coarse-grain filters is $160,000.

(9) In order that the problem may be viewed from the broadest standpoint, the above figures after being verified or corrected by further study and tests should be compared with the estimated total annual expenditure necessary to purify the water. If the difference in annual charge for the two types of sewage plants equals the annual charges for a water-purification plant, then, on financial grounds alone, the solution of the pure-water problem would be the installation of a water-purification plant, together with a sewage plant to remove the objectionable suspended matter, provision being made for disinfecting during the summer time, the sewage thus clarified.

(10) Before definite conclusions can be drawn regarding the most economical plan for treating the sewage, there should be conducted during the period of about a year, a series of actual tests and experiments on the various feasible methods.

Necessary equipment and facilities for making these tests could be readily installed near the present outfall sewer. The various features which should be investigated comprise in general the study of the character of the city sewage discharged at the main outfall, and also of that discharged through the various main branches; a study of the most suitable design of tanks and filters for use under local conditions; a study of the possibility of drying sludge along the lake front without creating a nuisance; the feasibility of clarifying the sewage by fine screens alone without the use of tanks; and the determination of the necessary amount of bleaching powder to suitably disinfect the effluent from the screening treatment, tank treatment, and filtration treatment, respectively.

In connection with these tests, it is also recommended that studies be made relative to the most economical method for purifying the water supply of Cleveland, in order that the cost involved in such water purification may be compared, with accuracy, to the difference in cost between the low-efficiency and high-efficiency sewage plants.

*Concluding portion of report made to Robert Hoffmann, City Engineer.

†Special Sanitary Engineer, Department of Public Works, Cleveland, Ohio.

Henry Fiddeman Lofland*

Henry Fiddeman Lofland, M. Am. Soc. C. E., General Manager of Erection of the American Bridge Co., of New York, whose death was noted in our issue of Jan. 18, was born in Milford, Del., and was in his 50th year at the time of his death. Mr. Lofland had been in poor health for the past three years, but did not give up active work until July 15, 1911, when he was granted a year's leave of absence, and returned to his old home in Delaware to recuperate.

Mr. Lofland graduated from the University of Virginia, obtaining a C. E. degree in 1883, and immediately became connected with the Baltimore & Ohio R.R. as Assistant Engineer on the construction of the substructure of the Susquehanna River bridge near Havre-de-Grace, Md., on the line then being built between Baltimore and Philadelphia.

The construction of the substructure of this bridge was notable as being one of the most important operations in deep pneumatic-foundation work that had been undertaken up to that time, and upon its successful completion Mr. Lofland served in the same capacity on the construction of the substructure of the Baltimore & Ohio R.R. bridge over the Schuylkill River at Philadelphia.

In June, 1886, upon the completion of the latter work, Mr. Lofland was engaged as engineer in charge of the construction of bridge substructures on the East Georgia & Florida R.R., and in December of the same year became Division Engineer on the Mobile & Birmingham R.R., having under his charge the construction of the substructure of the Tombigbee River bridge. In July, 1887, he was made Division Engineer on the construction of the Louisville, St. Louis & Texas R.R., remaining in that position until February, 1888, when he took charge of the surveys for the Louisville and Jeffersonville bridge over the Ohio River, near Louisville, Ky.

In April, 1888, Mr. Lofland returned to the Baltimore & Ohio R.R. as Assistant Engineer on construction and remained in this position until April, 1891, when he accepted an appointment as Assistant Engineer of Erection of the Edge Moor Bridge Works, of Wilmington, Del.

Six years later Mr. Lofland was promoted to the position of Engineer of Erection of the Edge Moor Bridge Works, which position he filled until the formation of the American Bridge Co., in 1900, when he was appointed Assistant Engineer

*Contributed by request by Mr. S. P. Mitchell, President of the Seaboard Construction Co., Philadelphia, Penn.

of Erection of that company. Upon the formation of the American Bridge Co., of New York, in 1901, Mr. Lofland was made Division Erecting Manager, having charge of all of this company's erection and outside construction work in the Eastern section of the United States, with headquarters at Philadelphia, and he held this position until 1906, when he was promoted to be General Manager of Erection, in general charge of all of the outside construction work of the company. He continued in this position up to the time of his death.

Mr. Lofland's engagement with the Edge Moor Bridge Works in 1891 proved to be the turning point in his career, for from this time on his professional activity was directed exclusively to the erection of bridges and steel structures. However, the broad knowledge gained from his experience in general railroad construction and the building of bridge substructures, was undoubtedly of the greatest value as a basis upon which to found his life work.

At the period when he entered on bridge work the present-day problems in bridge erection, which are due to the enormous increase in size and weight of structures, and particularly the problems encountered in the renewal of railway bridges under the most exacting traffic conditions, existed only to a very limited degree; consequently the organization, methods and appliances in use were naturally crude, and this branch of bridge building was only beginning to be recognized as a specialty requiring the ingenuity and skill of educated engineers. It may be fairly said that no one has contributed more than Mr. Lofland to the marked advancement and development that has taken place in the art in the last 20 years, during which time he was connected with the erection of some of the largest bridges in the country.

Mr. Lofland was the happy possessor of qualities making for success which are seldom found in one person—natural engineering talent, resourcefulness, force of character, and remarkable energy, combined with executive ability of a very high order and the faculty of handling men. He was, moreover, a man of sterling integrity in his business and personal relations and commanded the respect and admiration of friends and opponents as well.

In addition to his professional qualifications there was another side to Mr. Lofland's character that stood out with equal prominence, namely, his social gifts. Possessed of a genial personality, engaging manner and an inexhaustible fund of natural humor, which made him a delightful companion, he formed lasting friendships wherever he went. He was a raconteur of much reputation, not only in the usual sense, but invented many of his own stories, and could turn the most commonplace incident into a humorous anecdote. With his love of social life and great popularity with both sexes, it is rather remarkable that Mr. Lofland never married. He is survived by one brother and three sisters.

The death of Mr. Lofland is not only a severe blow to his friends, but a serious loss to the engineering profession.

Notes from Engineering Schools

PENNSYLVANIA STATE COLLEGE—Work in "Character Training" is being carried on by the instructors in the Engineering Department of this college, though somewhat in experimental fashion and with a view to eventually developing an adjunct to the usual technical training. By action of the engineering faculty, each instructor is required to give certain time and attention to a general discussion before his students of those mental characteristics which should contribute to their success. The instructors so far have drawn their material from knowledge of prominent engineers, from published biographies, from items of news appearing variously in newspapers or magazines, and from personal experience with other men. The work is presented to the students in the hours scheduled for regular studies. Effort is made to avoid ordinary "preaching," and the attempt is to bring to the students by illustration those ideas of ethics and patriotism necessary for the highest success of any engineer or any citizen; particular attention is also paid to the cultivation of originality, energy, loyalty, accuracy, fair dealing and accommodation with employees, employers and colleagues.

There is an informal consideration of the work at each faculty meeting when methods and results are discussed. At the end of each semester each instructor is expected to make a detailed written report to the Dean on methods, class time used, time expended in preparation, and an opinion as to the value obtained and improvements possible.

At this institution the students in the engineering school are required to carry twelve hours of advanced English during freshman and sophomore years, six hours of industrial history in the junior year, and in the senior year ten hours distributed between political economy, accounting, corporation and labor organization, contracts and specifications, etc. These subjects are of collegiate grade and are not covered by the entrance requirements to any institution. To accommodate this general work, it is necessary to slightly curtail instruction in some of the strictly technical subjects.

A Butting Collision, near Wittenberg, Mo., Jan. 18, on the St. Louis & San Francisco R.R., resulted in the death of three trainmen and one other was fatally injured. The accident is ascribed to a failure of the train order system.

A Car Fell from an Embankment, Feb. 6, on the Scott Haven division of the Western Pennsylvania Ry. (electric), near Coulterville, Penn. Of the 20 persons on board, four were killed. Reports state that the car was derailed on a curve while running at high speed and went down a 200-ft. embankment.

The Steamship "Allegheny," of the Hamburg-American Line, sank, Feb. 2, about 75 miles northeast of Cape Henry off the Virginia coast, after a collision with the British steamship "Pomaron." The "Allegheny" was a comparatively small vessel, 310 ft. in length, with 38-ft. beam and 1606 registered tonnage. She sailed from New York on the day of the accident for Central America and the West Indies with a heavy cargo of flour, cloth and various manufactured articles. Her two passengers and the crew were taken on board the "Pomaron" and reached port in safety.

The British Submarine "A 3" Was sunk, Feb. 2, after a collision with the gunboat "Hazard" off the eastern end of the Isle of Wight. Her crew of 14 men were drowned. Reports state that the submarine rose from the water directly in the path of the gunboat. The "A 3" was a single-screw submersible of a modified Holland type, 100 ft. in length, with a beam of 12 ft. 8 in. and displacement of 180 tons.

Anti-Rolling Tanks, of the Frahm type, described in Engineering News, Feb. 9, 1911, p. 181, have been installed on the new Cunard transatlantic liner, the "Laconia," which reached New York on her maiden voyage Jan. 29. The "Laconia" is 625 ft. long, 72 ft. wide and has a gross tonnage of 18,100 tons with a displacement of 25,000 tons. She is equipped with reciprocating engines. The new anti-rolling tanks consist of two water tanks divided into compartments placed amidships on each side of the ship, connected across the vessel at the top by air trunks and at the bottom by specially constructed water passages. The tanks are partially filled with water, and the movement of the ship is checked by the water flowing from one side to the other through the passages. To provide for changes in the movement of the vessel, the water in the tanks can be regulated to suit the circumstances. The "Laconia" is the first transatlantic ship to be provided with the Frahm tanks. It is reported that the first voyage showed the device to be most satisfactory.

New Records for Aerial Flight—At Senlis, France, Jan. 20, John Varrept and three passengers rose with a monoplane flyer to a height of about 3530 ft.

At Douzy, France, on Jan. 26, Henri Molla, with a biplane flyer carrying four other passengers (total load about 950 lb. exclusive of fuel) remained in the air 1 hr. 6 min.

Maurice Tabuteau, using a monoplane flyer, at Pau, France, Jan. 24, by a series of circular flights, covered 200 km. in 1 hr. 54 min. 21 sec., 250 km. in 2 hr. 22 min. 57 sec., and 300 km. in 2 hr. 51 min. In two hours he covered 127.63 miles; in three hours 196.10 miles. These are "official records," but the rates have actually been surpassed by "unobserved" flights as by Pierre Vedrines, a week before, when he covered 142 km. (88.33 miles) in one hour.

A City Plan Commission has been created at St. Louis, Mo., and has been given an appropriation of $5000 to conduct its work. Mr. Walter B. Stevens is Secretary of the Commission.

Electric Storage Battery Locomotives have been proposed by Mr. Edison for operating the suburban traffic of the Illinois Central R.R. at Chicago. Some experiments are to be made with his storage-battery motor cars, but single cars could not handle the traffic, and the suggestion was made to equip a train with a storage-batery tender to furnish the necessary power.

Freight Rates on Empty Cement Sacks are still under consideration by the Western Classification Committee, the meeting at Galveston, on Jan. 16, having adjourned without final decision. The proposed increase in freight rates will be taken up again by the Committee at its next meeting, to be held in Chicago a fortnight hence. Mr. Gordon Wilson, 72 West Adams St., Chicago, is Chairman of the Committee of the Association of Cement Manufacturers, which is opposing the increase in rates.

The Commission Plan of City Government has been adopted by seven New Jersey cities and towns since the passage of the enabling act by the legislature in the spring of 1911. The plan has been defeated in ten municipalities. A list of the cities which have voted on the proposition, with the votes for and against and the total population of each city, follows:

	For	Against	Population
Bayonne	2,212	2,217	55,545
Cape May	176	304	2,471
East Rutherford	174	265	4,275
Garfield	196	251	10,213
*Hawthorne ..	166	123	3,400
Hoboken	2,969	4,922	70,324
*Irvington ...	619	545	11,877
Jersey City...	11,585	13,068	267,779
*Margate City	44	12	129
Metuchen	118	209	2,138
New Brunswick	1,295	2,521	23,338
*Ocean City..	188	181	1,950
Orange	1,294	1,380	29,630
*Passaic	1,789	859	54,773
Paterson	4,877	8,645	125,600
Rahway	622	71	9,337
*Ridgewood ..	481	207	5,416
*Trenton	6,792	4,890	96,815

*Proposition adopted; adoption requires an affirmative vote equal to 30% of the vote cast for members of the legislature at the last preceding election.

An International Coal Smoke Abatement Exhibition is to be held in the Royal Agricultural Hall, Islington, London, England, from March 23 to April 4, 1912. Exhibits will be classified under smokeless fuels, domestic heating, other heating, various types of furnaces for industrial plants, testing appliances, fans and ventilating apparatus, and devices to prevent the emission of dust or dirt from chimneys. The exhibition will be held under auspices of the Coal Smoke Abatement Society.

The Hudson River Bridge Question is again in a slightly more active phase. The interstate bridge project, studies for which by a joint commission of New York and New Jersey have produced few results so far, is to be promoted by further state appropriations for bridges, etc. The old North River Bridge Co. project, which exists under a Federal charter requiring work to be begun by 1912, is represented in a bill introduced in the U. S. Senate aiming to extend the time to 1922. This project has in the past had many discouragements in its business aspects, chiefly in failing to secure the coöperation of the railways as necessary to assure the profitable use of the bridge. It is believed that there are still possibilities in this direction, however, and the extension of time is requested for this reason.

Great Bridges of Monumental Character across the Niagara River, which forms the international boundary between Canada and the United States, are proposed by the National Committee, which has in charge the celebration of the one hundredth anniversary of peace among English-speaking people to occur in 1914-15. An appropriation of $500,000 for the construction of such bridges, the creation of international parks along the Niagara frontier and the erection of boundary monuments is provided by a bill now pending in the New York Legislature.

Rapid Work in Hard Rock Tunneling was done by the T. A. Gillespie Co. in driving the tunnel for the Catskill water supply under the Hudson River at Storm King, which was "holed" on Jan. 30, as recorded in our last issue. The contract for the driving of the tunnel was awarded to the Gillespie Co. in June, 1911, after shafts 1100 ft. deep had been sunk on either shore and about 200 ft. of tunnel driven at one end. The contract date for completion, including the lining of the tunnel and shafts with concrete, is Apr. 1, 1913. From the time of beginning work until the holing of the tunnel on Jan. 30, the Gillespie Co. drove over 2500 ft. of tunnel, at an average rate for the two headings of over 360 ft. per month. On the heading driven from the west shaft there was maintained an average rate of progress of 265 ft. per month for the distance driven of 1744 ft. In comparing this with other records of rapid tunnel driving, it should be remembered that the Catskill aqueduct is to be 14 ft. 6 in. in finished interior diameter. As the rock pressure tunnels are lined with concrete, the rock has to be taken out to a clear diameter of some 17 ft. The Catskill tunnel was driven all the way through hard granitic rock and all material had to be handled through shafts 1100 ft. deep.

Grouting a Water Bearing Rock Seam against heavy pressure was accomplished in driving the Catskill water supply tunnel under the Hudson River at Storm King. When the east heading of this tunnel had advanced a short distance from the shaft, a seam was encountered in the rock from which a considerable volume of water issued. While the amount of water was small compared with the capacity of the pumps, it was deemed best to close the seam if possible, in order that the pump capacity might be available for handling larger bodies of water which might be encountered later. As the tunnel is 1100 ft. below the water surface in the Hudson, much doubt was felt as to the ability to force in grout against such a high head. The seam was closed with a ring of masonry, however, and the flow from it was thus concentrated into a pipe. Connection was then made to this pipe from a powerful steam pump and grout was forced in against the pressure of the water. In order to overcome the difficulties in connection with handling the grout itself in a high-pressure pump, the grout was placed in a heavy steel reservoir, which after filling with grout was closed and a pipe from a high-pressure pump was connected to it so as to force in water on top of the grout, and force it out through the delivery pipe at the bottom. In this way a pressure was attained considerably above the pressure of the percolating water. Grout was forced in until the water bearing cavities were closed and the seam is now perfectly dry.

New York Subway Work is progressing slowly. A recent report by the chief engineer of the Public Service Commission shows that while the Brooklyn Fourth Ave. subway is well advanced, in fact is near completion, very little work has been done on the new Lexington Ave. subway. Six contracts, aggregating about four miles long, were reported as being under way Jan. 15, 1912, five of these being under one contractor. A seventh section is soon to be started. All the work is required to be done under maintained street traffic, a plank roadway surface being placed and excavation carried on beneath. About half a mile of such temporary roadway has been laid; earth and rock excavation is being carried on over a somewhat greater length of line, and at one or two points shafts are being sunk for attack by tunneling.

The Brooklyn Fourth Ave. subway is about 80% completed. It is divided into six contract sections, at an aggregate of contract prices of $14,807,000. Over 2500 men are now employed on this work. The most advanced section (see Eng. News, July 27, 1911, p. 106) is 95% completed, while the most backward is 67% completed.

The southern terminal part of the Center St. loop subway, including the terminal station under the new Municipal Building and the approach thereto, is also being built now. It has been dormant for a long time on account of the Municipal Building work, although the rest of the loop has been completed two years or more, and the total investment of some $10,000,000 has been lying idle.

Personals

Mr. W. F. McClure, of Berkeley, Calif., has been appointed State Engineer of California, succeeding Mr. Nathaniel Ellery, M. Am. Soc. C. E.

Mr. Walter E. Knox, formerly chairman of the board of examiners of the Illinois Central R.R., has been appointed Trainmaster at Champaign, Ill.

Mr. W. B. Gatewood has been appointed Division Engineer of the Chicago Division of the Chesapeake & Ohio Ry., at Peru, Ind., succeeding Mr. L. N. Jackson, resigned.

Mr. James M. Motley, of New York City, has been appointed Purchasing Agent of the Panama Tramway Co., which is about to build a street-railway system in the city of Panama.

Mr. G. P. Wern has resigned the position of Manager of the hoisting-engine department of the New York office of the Mead-Morrison Manufacturing Co., to devote his time to private interests.

Messrs. Semple S. Scott and H. Rose have formed the Scott-Rose Co., Engineers, with offices in the Marquette Bldg., Chicago, Ill. Mr. Scott is President and Mr. Rose, Secretary-Treasurer of the company.

Mr. J. C. Calhoun, Jr., formerly Field Superintendent of the Charleston Engineering & Contracting Co., of Charleston, S. C., has resigned to accept a similar position with Holiday & Crouse, of Greensboro, N. C.

Mr. Ralph Bennett, Assoc. Am. Inst. E. E., formerly Chief Engineer of the Great Western Power Co., San Francisco, Calif., is now Chief Engineer of the Dominguez Land Co., Title Insurance Bldg., Los Angeles, Calif.

Mr. A. W. Sullivan, formerly General Manager of the Missouri Pacific Ry., has been elected Chairman of the American Railway Association committee on railway mail pay, with headquarters at 75 Church St., New York City.

Mr. Charles Booth has been appointed District Manager of the New England territory of the Chicago Pneumatic Tool Co., of Chicago, Ill., succeeding Mr. J. M. Towle, resigned. Mr. Booth was Vice-President of the company until Sept. 1, 1911, when he resigned owing to ill health.

Mr. Ralph H. Stearns, Assoc. M. Am. Soc. C. E., has resigned his position as Assistant Designing Engineer, Board of Water Supply of the City of New York, to accept the position of Division Engineer in charge of design of the new Hartford, Conn., water supply, under Mr. C. M. Saville, M. Am. Soc. C. E., Chief Engineer.

Mr. George L. Radcliffe, formerly Superintendent of Transportation of the Cleveland Ry. Co., Cleveland, Ohio, has been promoted to be General Manager of the same, succeeding to part of the duties of Mr. J. J. Stanley, who has been both President and General Manager. Mr. Stanley continues as President of the company.

Mr. Williston Fish, formerly Assistant to the President of the Chicago Rys. Co., of Chicago, Ill., has been promoted to be General Manager, a new position covering a part of the duties hitherto performed by Mr. J. M. Roach, who has been both President and General Manager. Mr. Fish is a graduate of the United States Military Academy, at West Point, and is a lawyer and an author.

Mr. James Oborne, General Superintendent of the Toronto division of the Canadian Pacific Ry., at Toronto, Ont., has been appointed General Superintendent of the British Columbia division of the same railway, with headquarters at Vancouver, B. C., succeeding Mr. F. F. Busteed, who goes to Winnipeg, Man., to take charge of a new division. Mr. Oborne worked his way up through the clerical departments of the Grand Trunk and Canadian Pacific Rys., to General Superintendent of Western division of the latter railway in 25 years. Since then he has been General Superintendent of nearly every division of the Canadian Pacific System.

Mr. A. C. Ridgway, formerly Assistant to the Second Vice-President of the Chicago, Rock Island & Pacific Ry., has been appointed Acting Second Vice-President, succeeding the late F. O. Melcher, who was killed in the wreck at Kinmundy, Ill., on the Illinois Central R.R. Other changes in the operating department of the same railway are as follows: Mr. W. M. Whitenton, General Manager of the third district at Fort Worth, Tex., is transferred to the first district at Chicago, Ill., succeeding Mr. W. S. Tinsman, resigned; Mr. C. W. Jones, General Superintendent at Davenport, Ia., is promoted to be General Manager of the third district, succeeding Mr. Whitenton; Mr. F. J. Easley, Division Superintendent at Rock Island, Ill., is appointed General Superintendent, succeeding Mr. Jones at Davenport.

Obituary

Frank C. Folz, a prominent contractor of Cincinnati, Ohio, died on Jan. 14, aged 67 years. He was born in Cincinnati, and was the son of Charles Folz, with whom he was associated for many years in a general contracting business.

Richard Vere Hunt, Assistant Engineer of the Bureau of Sewers, Borough of Brooklyn, New York City, died Jan. 31, at the age of 51 years. He had been connected with the Bureau of Sewers for 15 years. He leaves a widow and four children.

Heinrich Gerber, prominent among German bridge engineers throughout the second half of the 19th century, died on Jan. 3, 1912, at 79 years of age. His name is most widely known for his use of cantilever trusses in a bridge at Hassfurt and a bridge at Bamberg in 1866. In the "Zentralblatt der Bauverwaltung" of Jan. 17, appears a biographical sketch by A. Rieppel.

Jakob Amsler, inventor of the polar planimeter, died on Jan. 3, at Schaffhausen, Switzerland. Born Nov. 16, 1823, near Brugg, Switzerland, he studied mathematics and physics at Jena and Körnigsberg, served a year at the observatory at Geneva, and took up teaching at Schaffhausen in 1851. In 1854 he invented the polar planimeter. At this time he started an instrument shop for making planimeters, and later this shop developed into a testing machine and scientific apparatus manufactory of wide note. An excellent portrait of Amsler is published in "Schweizerische Bauzeitung," of Jan. 13, with an appreciative biographical sketch, from which the above dates and facts are taken.

Isaac A. Sweigard, former General Superintendent of the Philadelphia & Reading Ry., died on Jan. 25, at St. Lucie, Fla., from blood poisoning resulting from the sting of a catfish. He was born on July 23, 1843, in Dauphin County, Penn. At 21 years of age he became a clerk with the Philadelphia & Reading Ry. The whole of his railway work was in the service of this company and its subsidiaries. He rose through the grades of station agent, train despatcher and division superintendent to the position of General Superintendent of the entire system in 1886. Thereafter he was made Assistant General Manager, and General Manager in 1892. From 1893 to 1900 he was General Superintendent of the main line division, retiring in December of 1900 after 36 years of continuous service. He is survived by a widow and two daughters.

George Schuyler Davis, formerly Associate Editor of the "Street Railway Journal," and at the time of his death Editor of the "Electric Traction Weekly," died recently at his home in Cleveland, Ohio. He was born at Wellington, Ohio, in 1875 and educated in the public schools of Cleveland. His journalistic career began on a local newspaper; soon afterward he entered the field of technical journalism and for a number of years was the editorial representative in the Middle West of the "Street Railway Journal." Later he became associated with the "Electric Traction Weekly," and at the time of his death was Vice-President and Secretary of the Kenfield-Davis Publishing Co. He was a charter member of the Central Electric Railway Association and an associate member of the American Electric Railway Engineering Association.

Dr. E. R. Buckley, M. Am. Inst. M. E., died in Chicago, Ill., Jan. 19, from pneumonia. He had recently moved to Chicago from Rolla, Mo., and established an office as a consulting mining engineer and geologist. Dr. Buckley was born in Millbury, Mass., on Sept. 3, 1872. He graduated from the University of Wisconsin in 1895, with the degree of B. S., receiving the degree of Ph.D. in 1898. For three years he was with the Wisconsin Geological Survey, and was then appointed Director of the Bureau of Mines and State Geologist of Missouri. In May, 1908, Dr. Buckley resigned this position to become Chief Geologist for the Federal Lead Co., in Missouri. He was well known as a writer on mining and geology, and while State Geologist of Missouri was the author of several valuable reports on the immense lead deposits in this state. He was President of the American Mining Congress in 1910 and was a member American Society for Testing Materials, the National Geologic Society, and many other national and local scientific societies.

W. F. Buck, M. Am. Soc. M. E., Superintendent of Motive Power of the Atchison, Topeka & Santa Fé Ry., died in his private car while en route to Los Angeles, Calif., on Jan. 31. He became ill with pneumonia at Albuquerque, N. M., a short time before, and was being hurried to Los Angeles on a special train. Mr. Buck's rise to prominence in the railway mechanical service was rapid. He began only twenty-odd years ago as a machinist with the Northern Pacific Ry., and in 1893 was a shop foreman for the same railway. From this position he was promoted to be general foreman of the shops at Missoula, Mont., in 1895, and four years later to a similar position at Helena, Mont. From 1902 to 1904 he was Master Mechanic of the Rocky Mountain division of the Northern Pacific Ry., at Missoula. He then entered the service of the Atchison, Topeka & Santa Fé Ry. as Master Mechanic of the Arizona division at Needles, Calif. From this position he rose by rapid strides to the office he held at the time of his death.

Edwin Hawley, Vice-President of the Chicago & Alton R.R., Chairman of the Board of Directors of the Minneapolis & St. Louis R.R., and Vice-President of the Toledo, St. Louis & Western R.R., died at his home in New York City on Feb. 1. He was born at Chatham, N. Y., in 1850, and at 17 years of age entered the railway service as a clerk on the Erie R.R. He was connected in clerical capacities with several railways in the Middle West and South from 1868 until 1890, when he became Assistant General Traffic Manager of the Southern Pacific Ry., at New York City, which position he held until 1902. In the meantime and subsequently he obtained large holdings in the other railways of which he became an officer and director. At the time of his death he was a controlling influence in what is known as the Hawley system of railways, including the Chesapeake & Ohio, the Chicago & Alton, the Iowa Central, the Minneapolis & St. Louis, the Toledo, St. Louis & Western, the Kansas City, Fort Scott & Memphis, the Missouri, Kansas & Texas and the Hocking Valley. Mr. Hawley was also a director in 41 other railway, public utility and industrial corporations.